Relationship Between Readmission and Access to Care
Among Kansas Elders with Heart Failure

Cynthia Ann Hornberger
1999

Relationship Between Readmission and Access to Care

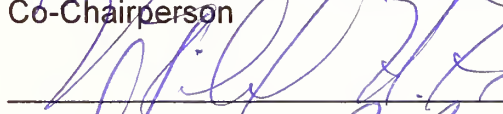Among Kansas Elders with Heart Failure

by

Cynthia Ann Hornberger
B. A., University of Kansas, 1976
B.S.N., Washburn University, 1978
M.S., University of Kansas, 1989
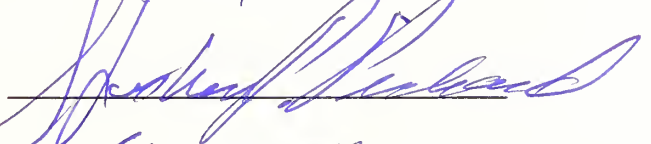M.B.A., University of Kansas, 1992

Submitted to the School of Nursing
and the Faculty of the Graduate School
of the University of Kansas in partial
fulfillment of the requirements for the
degree of Doctor of Philosophy.

Dissertation Committee:

Barbara E. Sorensen
Co-Chairperson

Roma Lee Taunton
Co-Chairperson

_____

_____

_____

Dissertation defended: April 21, 1999

ABSTRACT

Heart failure, the most common diagnosis related grouping (DRG 127) billed to Medicare, is the only cardiovascular disorder that is increasing in incidence and prevalence (Funk & Krumholz, 1996) as the population ages (Rich, 1997). The 1999 total costs of care for heart failure are expected to exceed $21 billion (American Heart Association, 1998). A significant portion of these costs is due to repeated hospital readmissions. Readmission is related to access, a concept that describes availability of services, individual and community social determinants of well-being, and utilization of healthcare services.

The primary aim of this study was to determine the relationship between access to health services and heart failure outcomes among 3,543 Kansans aged 65 years and older who were discharged with DRG 127 during 1995. Individual-level and ecological-level analyses of two samples stratified by subject residence in a metropolitan statistical area or non-metropolitan statistical area examined the relationships between readmission and select access variables of availability of hospitals, emergency transportation, specialty and/or primary care providers, skilled home care, dual eligibility status, and county-level social determinants.

Results

Individual-level. The 30-day readmission rate for any diagnosis of 16.9% for all subjects was similar to the national average of 17.2%. For both

i

stratified samples; significant, positive relationships between increased six month readmission for any diagnosis and being male, having increased comorbidities, having dual eligibility, and receipt of skilled home care did not support the hypothesized relationship that increased access to healthcare services decreases the frequency of hospital readmission for any diagnosis for elderly heart failure patients over a six month period.

Ecological-level. Social determinants did contribute to the prediction of readmission for any diagnosis within six months from hospital discharge coded DRG 127. Increased readmission rates were related to increased unemployment rates, increased dual eligibility rate, and an increased mean distance from residence to site of index hospitalization. The combination of traditional access and social determinant factors successfully expanded the predictive model to explain the variability in readmission for heart failure and provided support for continuing inclusion of social determinants as important indicators of overall community well-being and individual health.

ACKNOWLEDGMENTS

I would like to thank each of my committee members for their contributions. I wish to thank Dr. Barbara Langner for her patience, her expert editorial skills, and her willingness to share her extensive knowledge of health policy. She has provided me with positive encouragement and constructive instruction throughout the dissertation process. I would like to thank Dr. Roma Lee Taunton for her encouragement and for modeling to me the role of researcher. I credit Dr. Michael Fox with teaching me about large data set analysis, and I thank him for his continued expert support. My coursework with him cemented my interest in health outcomes research. Dr. Steve Pickard and Dr. Ed Ellerbeck have enthusiastically supported my research, and I thank them for their time and energy. I would also like to acknowledge special faculty who made a difference in my doctoral education. Dr. Ann Cobb has mentored me as I have developed my skills as a nurse researcher. Dr. Pam Duncan is a chosen mentor who has guided my decision making about future career choices. I want to especially thank Dr. Nancy Hoffart as my wise adviser who gently prodded me to keep my priorities straight while maintaining my academic and research endeavors at the highest standard. Finally, I wish to thank my classmates, Marian, Katherine, Barb, Nan, Bob and Ginger, for the camaraderie and mutual respect we shared.

DEDICATION

This dissertation is dedicated to my family. I have been blessed with a supportive husband and two sons who have accepted my aspirations and encouraged me along the way, bearing many burdens to allow me to achieve my goals. It is my sincerest wish that you know how much I appreciate your love and support over these many years. I could not have done it without you. To my husband Steve, thank you for your unselfish help and for your continual encouragement of me. I acknowledge that this goal would not be attained without your personal sacrifice. For my sons, Ryan and Jeff, I hope you will recognize that through hard work and commitment one can achieve the goals set before them. I thank you for your overwhelming love and understanding for your mother. I would also like to dedicate this work to my parents, Clyde and Eva Cramer, and to my husband's parents, Fremont and Louise Hornberger. My parents instilled in me the importance of hard work and the love of learning, but they taught me to laugh as well. I hope you are proud of me, as I am of you. To my husband's parents, thank you for your unconditional love and acceptance of my aspirations.

TABLE OF CONTENTS

LIST OF TABLES

Table   Page

LIST OF FIGURES

CHAPTER I

Introduction

Heart failure is the leading cause of mortality and morbidity in the elderly. In terms of resource utilization, heart failure is the most common diagnosis related grouping (DRG 127) Medicare expenditure category (Graves, 1992). In 1992, heart failure accounted for 875,000 primary hospital admissions, an additional 2 million hospital admissions with heart failure as a secondary diagnosis, and 3 million physician office visits (Konstam et al., 1994). A significant portion of the costs associated with heart failure was due to repeated hospital readmissions. Readmission rates for heart failure within the first 14 days to 1 year range from 2.9 to 47.5% (Ashton, Kuykendall, Johnson, Wray, & Wu, 1995; Lazarre & Ax, 1997; Reitsma et al., 1996; Venner & Seelbinder, 1996; Wolinsky, Overhage, Stump, Lubitz, & Smith, 1997). In 1999, the total annual costs of care for heart failure are expected to exceed $21 billion (American Heart Association, 1998).

Statement of the Problem

Despite substantial medical treatment innovations, heart failure is the only major cardiovascular disorder that is increasing in incidence and prevalence (Funk & Krumholz, 1996) as the population ages (Eriksson, 1995; Rich, 1997); with more than 75% of patients with heart failure in the United States age 65 years or older (Kannel & Belanger, 1991). Hospital readmission for persons with heart failure is often an indicator of poor health outcomes

(Chin & Goldman, 1997). Hospital readmission, in general, is related to a variety of factors collectively described as access to care.

Access to care can be separated into three major components describing (a) the availability to care; (b) the individual-level characteristics of the population; and (c) the ecological-level, or community, characteristics of the population. Availability to care includes the time and distance to services, the timeliness of delivered services, and the quantity of services per population. Healthcare services include emergency and/or community hospitals, emergency transportation, specialty and/or primary providers, and skilled nursing home health care (skilled home care).

Individual-level population characteristics include the demographic characteristics such as age, sex, educational level, and degree of illness which predispose individuals to seek care; the behavioral characteristics such as health-seeking behavior; and the enabling characteristics which provide the "means" for individuals to seek care, such as income and insurance coverage.

Ecological-level population characteristics include the cultural attitudes and beliefs about health and illness, and the environmental characteristics describing community well-being. Community well-being is measured by social and societal determinants such as rates of home ownership, unemployment, violent crime, and age-adjusted death per population. These social and societal characteristics have been shown to influence the health of

a population (Lantz et al., 1998; Link & Phelan, 1996; Marmot, 1996; Marmot, Ryff, Bumpass, Shipley, & Marks, 1997; Williams & Collins, 1995). Conceptually, social and societal determinants represent predisposing and enabling indicators of potential access to healthcare services.

Access to care is a complex phenomenon which is difficult to fully describe and to fully understand. This examination of heart failure outcomes for the Kansas elderly will be focused on select pertinent, though not all-encompassing, aspects of access to care. An integrated approach to examining access to health care as measured by availability to healthcare services, enabling and predisposing individual and social determinant factors, and utilization of healthcare services provided a broader understanding of the factors influencing the incidence and exacerbation of heart failure. The current study examined variability in the heart failure outcomes of readmission and mortality using both individual and county level data describing access. The merger of individual-level records of care and ecological-level data on social and societal determinants of health provided an innovative examination of previously untested relationships.

<div align="center">Purpose</div>

The purpose of this study was to determine the relationship between access to healthcare services and heart failure outcomes. Two levels of analysis were performed to examine this relationship. Research hypothesis one examined the relationship between the dependent variable of

readmission rate and the independent causal variables describing the availability of hospitals, healthcare providers, emergency transportation; the individual-level population characteristics of age, sex, comorbidity, and dual eligibility for Medicare and Medicaid insurance programs; and the individual use of skilled home care. This question was examined at an individual level of analysis with a stratified sampling based upon the population density of the county of residence. Research hypothesis two examined access at an ecological level by aggregating all variables to the county level, and adding county level social determinants of health as independent causal variables.

Research Hypotheses

Two hypotheses guided this study. They were:

1. H_1: Increased access to healthcare services decreases the frequency of hospital readmission for elderly patients with heart failure over a six month period.

2. H_1: Social determinants of social stability (single-parent household rate, home ownership, unemployment rate), socioeconomic status (median family income, poverty status, percent population with a college degree), or overall societal health (high school graduation rate, violent crime rate, motor vehicle injuries, age-adjusted death rate) further explain variability in hospital readmission for elderly patients with heart failure over a six month period.

Definition of Terms

Terms for this study were defined as follows:

Readmission

Variables to describe readmission rates included readmission for DRG 127 and readmission for any diagnosis for 0 to 30 days, 0 to 90 days, and 0 to 180 days. Readmissions were counted from the date of discharge for the index event hospitalization with a discharge diagnosis coded DRG 127 through 180 days thereafter. Readmission occurrence measured the realized access in the conceptual framework.

Access

Variables to describe access to healthcare services included the availability of limited service hospitals (RPCH) and/or community hospitals, emergency transportation, specialty and/or primary providers (including physicians, physician assistants, and nurse practitioners); and the receipt of skilled home care. Availability was defined by the distance from residence to the site of the index event hospitalization, and by the ratio of county population per service provider. The receipt of skilled home care measured the realized access to home healthcare services provided by licensed nurses.

Social Determinants

The county-level variables selected to describe social stability, socioeconomic status, and overall societal health were identified by Singh et al. (1998) using factor analysis to create multidimensional indices of social

status and health. In this study, the variables describing social stability included the percent of single-parent households, the percent of population owning a home, and the percent of civilian population age 16 and over who were unemployed. The variables describing socioeconomic status included the median household income, the percent of population below 200 percent poverty, the percent of persons over age 65 that had dual eligibility for Medicare and Medicaid, and the percent of persons age 25 and older with four or more years of college. The variables describing overall societal health included the percent of students graduating from high school, the violent crime rate per county population, the number of motor vehicle injuries per county population resulting in injury, and the age-adjusted death rate.

Comorbidity

Comorbidity was included in the study to measure the presence of additional illnesses that could alter the relationship between readmission rate and access to care. Comorbidity was described as having other significant illnesses in addition to heart failure at the time of the index hospitalization discharge. Comorbidity scores were calculated using the Charlson Comorbidity Index (Charlson, Pompei, Ales, & MacKenzie, 1987).

Mortality

Variables to describe mortality included the categorical variables describing death within six months of the index event discharge and death within twelve months of the index event discharge, and a continuous time

6

variable describing the number of days each subject was alive during the six month data collection period. Mortality was included in this study to verify the validity of using the Charlson Comorbidity Index score as an accurate indicator of comorbidity in subjects with heart failure.

<u>Conceptual Framework of Access</u>

In 1999, the projected cost of providing health care for the treatment of heart failure in the United States is $21 billion. A better understanding of the relationship between access to healthcare services and heart failure outcomes is needed. This retrospective cohort study describing the relationships between health system access variables and the dependent variables of readmission rate and death examined a broader range of factors which may contribute to heart failure outcomes. The merger of administrative discharge data and vital statistics provided a more comprehensive approach to describing the variability in negative heart failure outcomes.

The conceptual framework used to guide this study included characteristics of the health delivery system and the population-at-risk for diminished access to care. Aday and Andersen first introduced the Framework for the Study of Access in 1974 to describe their approach to studying issues of access and utilization. The model was strongly influenced by Donabedian's quality of care measures of structure, process, and outcomes (1974). Over the next twenty years, Aday and Andersen continued to study access issues using the framework (Aday, 1993; Aday, Andersen, &

Fleming, 1980; Aday, Fleming, & Andersen, 1984). Figure 1 depicts the

current model derived in 1980. The model includes the subjective indicators

of realized access, which were not examined in this study.
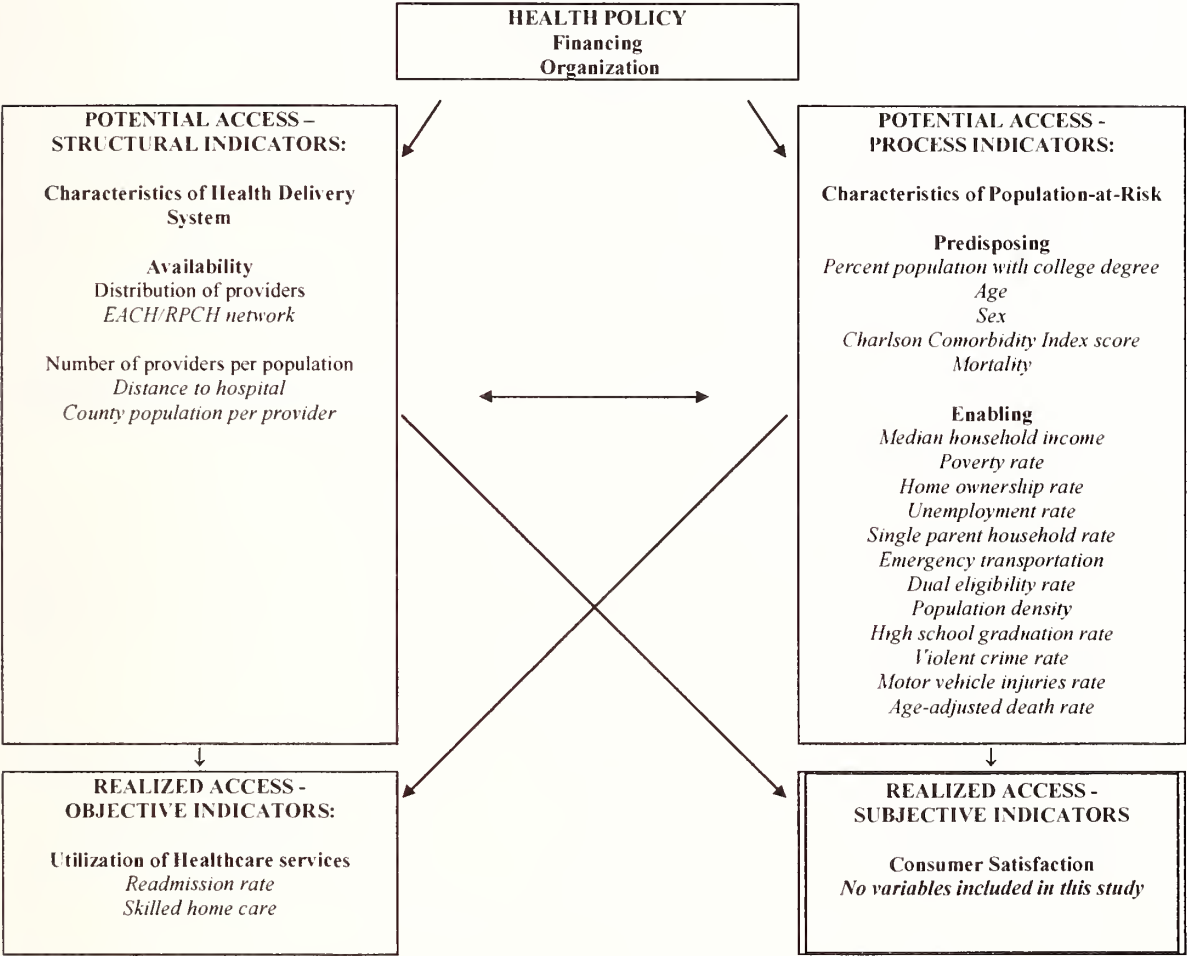
Figure 1. Framework To Study Access. The variables included in this study measured

structural indicators of potential access, process indicators of potential access, and objective

indicators of realized access. Subjective indicators of realized access variables were not

included in this study.

The model separated access into potential and realized access categories. Using Donabedian's (1980) quality framework of structure-process-outcomes, each of these concepts was further divided into structural and process indicators. The structural indicators of potential access described the availability of healthcare providers measured by the distance to, or by the distribution of, providers. The process indicators of potential access described the characteristics of populations-at-risk measured by predisposing and enabling factors. A more detailed description of the major concepts of the model is provided in following sections.

<u>Health Policy</u>

The concept, health policy, was considered the starting point of the framework. Subsumed under health policy were two integral components of health policy, financing and organization. Financing described the system-wide policy decisions required for fiscal integrity of healthcare delivery systems. Organization described how the system utilized resources, including the manner in which medical personnel and facilities were coordinated and controlled while providing medical services (Andersen et al., 1970). Entry into the organization included identifying what barriers which must be overcome, the criteria which must be satisfied before a person seeking care actually becomes a patient in the healthcare services system, and entry into the system. The organizational structure described the system characteristics that determined what happened to the patient following actual entry into the

system. Examples of structural issues included whom the person saw, and how he was treated.

Access

The two components of access in the framework were potential access and realized access. Potential access described the characteristics of the health delivery system (defined as the availability and distribution of health care providers and facilities) and the characteristics of the population-at-risk (defined as their age, health status, insurance coverage, and income levels). Realized access included the utilization of healthcare services and the general satisfaction with those healthcare services.

Potential access. The structural indicators of potential access described the availability of healthcare services. Availability was described by the volume and distribution of healthcare services. Availability reflected the integration of services within networks. The process indicators of potential access described the population-at-risk. A population-at-risk was vulnerable to a lack of access to care based on sociomedical morbidities. The characteristics of a population-at-risk included predisposing, enabling, and need components. Predisposing factors described the propensity to use services and included age, sex, ethnicity, and values concerning health and illness. Enabling factors described the "means" to use services, such as income, insurance coverage, and attributes of the community, such as the rural/urban distinction. Need factors referred to the level of care required as

perceived by either the individual or by the delivery system. Predisposing and enabling factors could be mutable or immutable. This separation recognized that certain variables could be changed while others were unalterable.

Realized access. Realized access variables measured the actual utilization of healthcare services by individuals and their reactions to those services. The objective indicator of realized access was the actual utilization of services. Characteristics of utilization included the type of service received; the site of care; whether the purpose was preventive, illness-related, or custodial; and the time interval in terms of contact, volume, or continuity. Contact was defined by the specified periods of time during which the person entered the system. Volume described the number of contacts in a given time interval. Continuity referred to the degree of linkage and coordination of medical services associated with a particular illness experience or the episodes of care related to a particular illness experience. The subjective indicator of realized access was consumer satisfaction, which measured the satisfaction of consumers with the quantity or quality of care and was not linked to a specific episode of care. Key issues were consumers' satisfaction with the convenience of care; care availability and cost; characteristics of the providers, including their courtesy; information the provider gave to the patient related to the illness; and the perception of the patient about the quality of the care received.

The Framework to Study Access depicted an uni-directional relationship between health policy and potential access, which in turn affected realized access. Structural indicators of potential access may affect process indicators of potential access, and vice versa. The logical premise of this framework was that potential access must exist before realized access could occur. The primary limitation of the Framework to Study Access to examine heart failure outcomes focuses on the lack of objective individual-level indicators of quality of care, such as differences in treatment regimens for heart failure. The influence of these indicators is acknowledged.

Application of the Model for this Study

This current study tested elements of the Framework to Study Access. The research hypothesis examined the relationships between structural and process indicators of potential access in an attempt to explain the variability in realized access, readmission for DRG 127 or for any diagnosis. No subjective indicators of realized access were examined in this study. In this study, the objective indicators of potential access were measured at the individual and ecological levels. Individual-level indicators included age, sex, comorbidity, mortality, and dual eligibility status. The remaining objective indicators of potential access were measured at the ecological level. Skilled home care described realized access at the individual level. The dependent variable, readmission for DRG 127 or for any diagnosis, was measured initially at the

individual level and then examined in the aggregated form at the ecological level.

The focus of this study was to examine the relationship between the characteristics of the healthcare delivery systems in Kansas and the characteristics of the population-at-risk for experiencing hospital readmission for DRG 127 or for any diagnosis as an outcome of heart failure. The population-at-risk in this study were Kansas elders hospitalized for treatment of heart failure during 1995.

<div align="center">Assumptions</div>

1. Readmission rate is a valid indicator of poor health outcome for individuals with heart failure. Comorbidity and mortality may affect the validity of the readmission occurrence, both of which can be measured and controlled for in the statistical analyses.

CHAPTER II

Review of Literature

This chapter provides a review of literature related to research in heart failure outcomes management. The topics are organized using the conceptual framework descriptions of (a) the characteristics of the health delivery system, (b) characteristics of the population-at-risk, and (c) the utilization of healthcare services. Specific topics include availability of health delivery systems, demographics of the rural elderly, heart failure epidemiology and treatment, social determinants of health, and heart failure outcomes management.

Characteristics of the Health Delivery System

Access to care has been studied extensively; yet singular approaches to studying access have not successfully described the complexity of this multifaceted problem. Aday, Andersen & Fleming (1980) conceptualized access using a broader approach by including characteristics of the health delivery system and the population-at-risk. Access to care was conceptually described by the structural and process indicators of potential access. The structural indicators of potential access described the characteristics of the health delivery system, availability of healthcare providers measured by distance to, or by distribution of, providers at the system (ecological) level.

Availability of Health Delivery System

Distance to care. Recent studies concluded that an increased distance to the hospital provider for acute and outpatient services was directly related

to a decreased utilization of inpatient services (Holloway, Medendorp, & Bromberg, 1990; Luft et al., 1990), decreased outpatient services (Piette & Moos, 1996), and an increased mortality rate (Piette & Moos). In a retrospective examination of 4,637 records of patients receiving care at Veteran's Administration hospitals who were discharged with a diagnosis of acute myocardial infarction in 1992, Piette and Moos found that patients living more than 20 miles from their admitting hospital were less likely to use ambulatory services and were more likely to die independent of age, comorbidity, or receiving out-patient follow-up.

Distribution of providers. Patient utilization of acute care services, particularly emergency care services, has been related to the patient's perception of viable health care alternatives and the perceived urgency. Hunt, DeHart, Allison, and Whitley (1996) found that a significant portion of the patients seeking emergency care did so because of a perceived absence of other viable primary care alternatives related to not having a doctor, a perception that better medical care was provided in the emergency department, or being advised to seek care at the emergency department when the private physician's office was closed. The authors concluded that these responses were most frequent among individuals who were insured through the public sector or were uninsured. A report by the General Accounting Office (1993) attributed the growth in emergency department

15

admissions from 1985 to 1990 to an increased use by Medicaid beneficiaries (34%), Medicare beneficiaries (29%), and the uninsured population (15%).

Rural residents have experienced unique and complex health care access problems. Key issues regarding rural access to care include whether the proximity of services affects the resultant quality of care and quality of health outcomes. No consensus is identified in the literature regarding these two issues. One important link in healthcare service delivery for rural residents is the proximity to hospital care. Diminished access to health care for rural Americans may occur as the result of rural hospital closures (Shreffler, 1996). Access to other healthcare providers may subsequently be diminished since the rural hospitals often served as the linkage between providers and those seeking care. Most recently, initiatives to improve acute care access in rural areas have focused on linking emergency care centers with larger, full service community hospitals (Campion & Dickey, 1995; Gamm, Kassab, Brannon, & Fennel, 1996; Zuvekas, Leifer, Rosenbaum, & Hughes, 1997), or through the inclusion of telemedicine services (Lindberg, 1997). Both these strategies have been adopted in Kansas as an attempt to correct the long-standing access problems of residents in rural areas (Hungerford & Simpson, 1991; Lindberg). Preliminary findings in one hospital using telemedicine services indicated an improved ability of health professionals to manage chronic disease symptoms with 38 rural patients in Ellis county (Lindberg).

The Omnibus Budget Reconciliation Act of 1989 established a delivery system innovation aimed at enhancing healthcare access for Medicare recipients by networking rural hospitals with larger community hospitals that provided a greater range of essential services (Langner, 1998). Kansas was one of seven states selected to implement this innovative delivery system.

In 1995, approximately 351,000 Kansans were age 65 years and older (Center for Health & Environmental Statistics, 1996). Kansas ranked 13th among all states in terms of the proportion of elderly to the total population (US Senate Committee on Aging, 1991). Over 65% of elderly Kansans live in rural areas (Beisecker, 1993). In the 30 sparsely populated frontier counties of Kansas, the rural elderly are most likely to have limited proximity to healthcare services. The Kansas EACH/RPCH program was implemented in 1991 to improve access for rural residents needing healthcare services. Hospitals applying for Essential Access Community Hospital (EACH) designation were required to have at least 75 beds and be no closer than 35 miles to another EACH. Rural Primary Care Hospitals (RPCHs) were designed to provide emergency services and primary care services and could provide only limited inpatient care. A rural network linked one EACH with one to six RPCHs and other healthcare providers. Twenty-two of the 112 rural facilities participated in the program (see Figure 2).

The Kansas EACH/RPCH program included nine networks with six EACHs, 16 RPCHs, five supporting hospitals, and two additional hospitals

pending certification from the Health Care Financing Administration as rural

primary care hospitals (Langner, 1998). The five supporting hospitals, four of

which were in Kansas, were hospitals larger than essential access hospitals

which were networked with the RPCHs. An evaluation of the RPCH/EACH

program conducted by the United States General Accounting Office (1998)

noted "RPCHs provide additional and, likely, much more proximate access to

health care for Medicare beneficiaries residing in the rural areas where the

facilities operate" (p. 2).

State-Designated Rural Health Networks
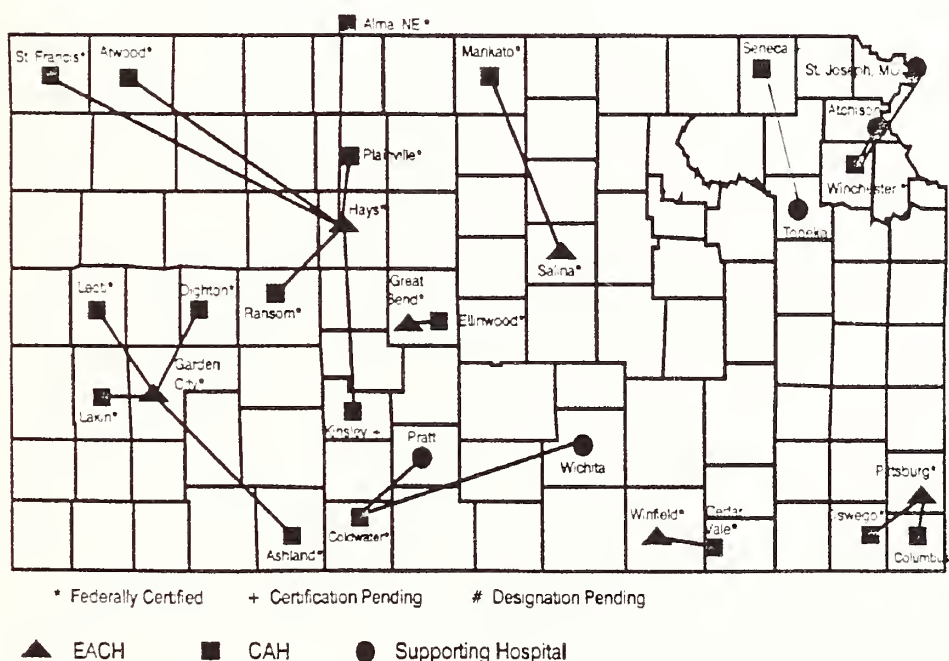
Figure 2. State-Designated EACH/RPCH Active Networks. Those locations

noted as CAH are the RPCH sites.

Access to acute care facilities, however, is only one point in the service continuum from which patients with heart failure require healthcare services. Trends reveal that hospital lengths of stay have decreased rapidly with patients being transitioned from acute care into long term or home-based health care. Significant differences in readmission rates exist between patients receiving continued care at home versus in a long-term care setting. Gooding and Jette (1985) found almost 40% of patients with heart failure discharged directly to home were readmitted to the hospital within six months, as compared to 20% of those discharged to a long term care facility. Decreased length of stay has increased the need for follow-up physical assessment, assessment of medication and diet compliance, and coordination between primary and secondary care providers (Gooding & Jette). Vinson, Rich, Sperry, Shah, and McNamara (1990) found the reasons for heart failure readmission from home included failed social systems (21%), failure to seek medical attention promptly when symptoms recurred (20%), inadequate follow-up (20%), diet noncompliance (18%), medication noncompliance (15%), and inadequate discharge planning (15%). One study examined the hospital readmission rates of subjects admitted to home care following an acute exacerbation of heart failure (Lazarre & Ax, 1997). The subjects received targeted teaching on disease management, were closely monitored by a registered nurse who assessed subjects for evidence of heart failure exacerbation and provided prescribed interventions. The 30-day and

90-day readmission rates were 2.9 and 8.8 percent, respectively, compared

to national averages of 17.2 and 32 percent for the same time periods.

Characteristics of the Population-at-Risk

At the individual level, the population-at-risk can be described by the

demographic and disease specific characteristics of persons with heart

failure. At the ecological level, social determinants describe societal

characteristics of the population-at-risk.

Demographic Characteristics

The focus of this study was elders with heart failure residing in a

predominantly rural state. The elderly age 65 years and older represent

12.6% of the United States population and 14% of the Kansas population (US

Bureau of Census, 1990). Demographically, rural residents are older and

poorer than their urban counterparts. They experience higher unemployment

rates, are less educated, and are more likely to lack health insurance (Krout,

1994). These process indicators of potential access are often associated with

impaired access to healthcare services (Aday & Andersen, 1984).

Rural communities offer demographic diversity but also represent an

identifiable segment of the American population, defined by some as a

distinct rural culture (Bigbee, 1993). A standardized definition of rural;

however, has been unattainable due to a lack of consensus about what

constitutes "ruralness". Davis and Droes (1993) noted that ruralness is often a

perspective, and not a static reality. The United States Census Bureau (1990)

defined rural as meaning either open country, or towns of less than 2,500 people. Another commonly used categorization separates population density into four categories; frontier, rural, densely-settled rural, and metropolitan statistical area (Office of Technology, 1990) as defined by the Office of Management and Budget, and the Department of Agriculture's rural-urban continuum codes (see Appendix A). In this rural-urban comparison study, rural is defined as a non-metropolitan statistical area.

Rural residents had poorer perceived health (Bigbee, 1993), had longer emergency medical service response times (Office of Rural Health Policy, 1990), traveled nearly twice as far to access emergency care (Edelman & Menz, 1996), experienced longer waiting periods before seeking health care (Horner et al., 1994), reported fewer physician visits (National Center for Health Statistics, 1991), and experienced greater financial barriers related to the costs of care (Blazer, Landerman, Fillenbaum, & Horner, 1995). Common characteristics attributed to the rural elderly; independence, self-sufficiency, dignity, privacy, and hardiness, may contribute to a delay in seeking health care, including emergency services (Lee, 1993; Murphy & Hepworth, 1996). These characteristics may confound the relationship between potential and realized healthcare access.

It has been well documented that utilization of acute care services increases as people age. Elders are also more likely to experience an increase in medical events requiring specialty care, rather than primary care

(Murphy & Hepworth). In a study of 70 hospitals in 25 states examining emergency department use, 15 percent of all visits were made by patients 65 years and older. Thirty-two percent of the elderly patients seen in the emergency department were admitted, as compared to 7.5 percent of the non-elderly patients (Strange, Chen, & Sanders, 1992).

One study, however, contradicted the findings of the preponderance of studies describing utilization patterns among the rural elderly. Using a large probability sample of 5,000 individuals age 70 years and older obtained from the National Center for Health Statistics' Longitudinal Study of Aging, McConnel and Zetzman (1993) found no differences between urban and rural elderly persons in the use of hospital or physician services.

Insurance. The research findings on the relationship of health insurance coverage and hospitalization are conflicting. Kassab, Luloff, Kelsey and Smith (1996) found no relationship between the income level or insurance status and actual hospital use for non-metropolitan elders, whereas Blazer et al. (1995) found the generalized "cost of care" to be a persistent barrier among rural elderly patients, despite Medicare coverage. As previously mentioned, the use of emergency department for primary care was positively related to being a beneficiary of government insurance or uninsured (U.S. General Accounting Office, 1993). No studies were identified that examined the relationship between elders who had dual eligibility status and the utilization of healthcare services.

The ability of a person to pay for needed healthcare services is influenced by the adequacy of health insurance coverage and their level of income. Since Medicare Part B does not reimburse most medication expenses, many elderly, particularly those with heart failure, may experience inadequate health insurance coverage. The elderly with very low incomes would be considered most at risk for diminished access; however, those who have dual eligibility for Medicare and Medicaid programs can access a benefit package which includes prescription medications. Thus, some elders with dual eligibility may actually have increased access to an important and necessary treatment of heart failure care. While no studies were identified that examined the relationship between dual eligibility status and medication use, a study conducted by Stuart & Grana (1998) examined the relationship between insurance coverage and medication use. These authors analyzed the results of 3,554 survey responses about health insurance, income, and medicine use for 23 common health problems. A strong and consistent relationship was found between elders with Medicare supplement insurance coverage and the increased use of prescription medicine as compared to elders with Medicare coverage alone.

Low income or lack of health insurance typically decreases access to primary care. Cordes, Doeksen, and Shaffer (1994) suggested that, in general, individuals with low incomes utilized emergency departments more frequently because of a lack of access to primary care secondary to

inadequate insurance status or decreased availability of primary care services. Mueller, Patil, & Boilesen (1998) used data from the 1992 National Health Insurance Survey to examine the relationship between insurance status and utilization of physician services and found the uninsured were 60 percent less likely to use physician services than were the insured.

The Population with Heart Failure

More than 4.9 million Americans have heart failure (American Heart Association, 1998). Heart failure is a clinical syndrome characterized by intravascular and interstitial volume overload, and manifestations of inadequate tissue perfusion, such as fatigue or poor exercise tolerance (U.S. Department of Health and Human Services, 1994).The five year mortality rate for individuals with heart failure is 50 percent (American Heart Association). For patients diagnosed with heart failure, sudden cardiac death occurs at six to nine times the rate of the general population. From 1979 to 1996, death from heart failure increased 119.9%. Hospital discharges for heart failure rose from 377,000 in 1979 to 870,000 in 1996. All categories of black men, black women, white men, and white women have an increasing rate of hospitalizations for heart failure with each decade of life from age 45 and older (American Heart Association; Gillum, 1993). The prevalence of heart failure between ages 35 and 64 is 1%, but approaches 10% after age 64 (Eriksson, 1995; Kannel, 1989; Schocken, Arrieta, Leaverton, & Ross, 1992). The prevalence of heart failure is both the result of an increasing disease

24

incidence and a decreasing mortality rate (Bonneux, Barendregt, Meeter, Bonsel, & van der Maas, 1994). Hospital and nursing home care accounted for $15 billion of the $19.6 billion of direct costs projected to be spent in 1999 for the treatment of heart failure. In 1995, $3.4 billion was paid for the treatment of heart failure among Medicare beneficiaries (American Heart Association).

The treatment regime for heart failure prescribed by physicians varies across individuals and is one factor describing the individual characteristics of the population of patients with heart failure. Heart failure treatment options may include (a) treatment of underlying and precipitating causes; (b) pharmacologic therapies of diuretics, angiotensin-converting enzyme (ACE) inhibitors, digoxin, isosorbide dinitrate, and/or beta blockers; (c) surgical correction of stenosis or valvular anomalies; (d) sodium, alcohol, or fluid restriction; and (e) regular physical activity such as walking (Aronow, 1997; Baker, Konstam, Bottorff, & Pitt, 1994; Doughty & Sharpe, 1997; Dracup, 1996). Coordination and support for these therapies requires intense education and monitoring for therapy compliance, untoward effects of therapy, and disease exacerbation, as well as ongoing psychosocial support for patients, families, and caregivers (Brass-Mynderse, 1996; Dracup; Dracup et al., 1994).

Physician practice patterns vary in the inclusion of innovative medication treatment options for the long-term management of heart failure.

Angiotensin-converting enzyme inhibitors have emerged as a significant intervention to reduce mortality by as much as 30% (CONSENSUS Trial Study Group, 1987; The SOLVD Investigators, 1991), yet up to 70% of eligible patients are not being treated with these drugs. The reasons cited for this finding included physician non-acceptance of the benefits of these drugs and physician concerns about appropriate drug dosages (Packer, 1996).

Social Determinants

Traditional approaches to reduce the negative outcomes of cardiovascular disease have been focused at the individual level of health management. Differences in these individual approaches only describe a portion of the variability in cardiovascular disease. In Kansas, a more thorough understanding of the underlying causes for cardiovascular disease prevalence variability is required. Kansas counties differ markedly in the prevalence of cardiovascular deaths, with Comanche and Cherokee counties demonstrating rates 40-50% higher than the state average (Singh et al., 1998).

The population characteristics describing community well-being, based upon the seminal work by Marmot, provide additional elements which may be contributing to the cardiovascular disease variability evident across the state. Marmot has demonstrated over the past two decades that an inverse relationship, described as a social gradient, exists between social class and cardiovascular disease (Marmot, 1996; Marmot et al., 1996; Marmot, Bosma,

Hemingway, Brunner, & Stansfeld, 1997; Marmot, Ryff, Bumpass, Shipley, & Marks, 1997; Marmot, Rose, Shipley, & Hamilton, 1978). Marmot found that an increasing cardiovascular mortality was associated with the decreasing social class status of British civil servants. Marmot's ongoing research is focused on identifying the complex mechanisms embedded within this relationship. Social class has been expanded to include a broader description of the population-at-risk, now described as the social determinants of health. Social determinants include descriptions of the differences in socioeconomic status, social stability, and overall societal health (Singh et al., 1998).

The social gradient between negative health outcomes and social determinants over the last twenty years has repeatedly been demonstrated in different populations experiencing a variety of disease processes (Cohen & MacWilliam, 1995). The social gradient exists despite continuing traditional public health interventions to decrease morbidity and mortality risks by reducing health risk behaviors such as cigarette smoking, alcohol drinking, sedentary lifestyle, and obesity (Lantz et al., 1997; Marmot, Ryff et al.). Further work is needed to determine which societal determinants provide the greatest explanation of cardiovascular disease occurrence and subsequent mortality. The most promising evidence related to cardiovascular disease suggests that differences in the social gradient may be related to personal psychological well-being and the relationship of the individual with the community at large (Marmot, Bosma et al.). Marmot, Ryff et al. described

health as not just the absence of disease, but rather a state of optimal, positive human functioning. They found that the most likely explanations for differences in the social gradient included features of the work environment, socioeconomic stability, and health behavior.

Preliminary studies in Kansas. In 1995, an ethnographic study was undertaken by the investigator as a member of a larger research team studying the issues of health, healthcare services, and long-term care in a rural Kansas community (Taunton, Redford, Cobb, Wright, & Forbes, 1995). Through personal interviews and focus groups, information was gathered about the perceptions held by 150 community members related to these topics. Six themes emerged from the individual and group perceptions: (a) transition in health care, (b) approach to change, (c) financial challenges, (d) discord versus harmony, (e) stress, and (f) increasing proportion of elders.

A secondary qualitative analysis using Leininger's categories of economics, social-kinship, cultural, political-legal, religion, technology, and education was conducted by the investigator focused on the responses to the question, "What is your vision of a healthy community?" (Hornberger & Cobb, 1998). An eighth category of environmental concern emerged from the data. Environmental concerns included physical and social descriptors such as uncontaminated water, decreased air pollution, pride in community appearance, and provision of recreational opportunities. The participant responses were further assimilated into coherent statements reflecting the

community's vision of a healthy community. The participants provided a rich

description of the primary and specialty healthcare services needed in the

community to achieve accessible and technologically adequate healthcare.

The participants also cited a variety of factors that were important both to the

health of individuals and the entire community; such as availability of jobs; a

need for people to care for each other; reduced crime; competent, positive,

and hopeful leadership; a harmonious religious community; members

possessing a positive life attitude; support for the school system; and a clean

and safe environment. In summary, this study supported the inclusion of

characteristics of the healthcare delivery system and the population-at-risk.

The findings of this study described health as a multi-faceted concept that

integrated both availability of healthcare services and social determinants as

key factors in achieving overall health of community residents.

In November, 1997, Hornberger completed a pilot study which merged

county-level data from the Kansas Health Institute's *Health Risk Behavior*

data set with county level data obtained from the Kansas Hospital Association

in order to examine rural access patterns for patients with cardiovascular

disease (see Table 1). In this study, the dependent variable, cardiopulmonary

disease, was defined as the combined hospital admission rates for DRG 088

(chronic obstructive pulmonary disease) and DRG 127 (heart failure and

shock). A retrospective analysis found significant differences in the frequency

of acute care admissions for cardiopulmonary disease among residents of

Kansas counties with different population densities. When correlational and scaling procedures were performed, acute care bed availability, staffed ambulance availability, and population density emerged as significant access indicators. The social determinant factors that were significant in this study included the crime rate, death rate, high school graduation rate, median household income, minority status, presence of indigent clinics, percentage of patients over 65 years of age, alcohol-related accidents rate, poverty rate,

Table 1

Understanding Rural Access and Utilization for Patients with

Cardiopulmonary Disease in Kansas

Study Design:	Retrospective, county-level analysis
Dependent Variable:	Combined county-level admission rates for DRG 088 (chronic obstructive pulmonary disease) and DRG 127 (heart failure and shock)
Significantly Correlated Independent Variables:	*Access variables:* Number of acute care beds per 50,000 population, population per staffed ambulance, population density (frontier, rural, densely-settled rural, metropolitan statistical area)
	Social determinant variables: Violent crime rate, death rate, high school graduation rate, median household income, minority status, indigent clinic rate, percentage of patients > 65 years, alcohol-related accidents rate, poverty rate, teen pregnancy rate
Results of Analysis of Variance:	Acute care admission for DRG 088 and 127 significantly decreased as county population density increased , $F (3, 101) = 11.93, p < .001.$
Results of Linear Regression:	The 13 structural and process indicators of potential access explained 40% of the variance of acute care admissions by county.

and teen pregnancy rate. These thirteen variables explained 40% of the variance of acute care admissions between counties. Indicators in the study

that were not significantly related to cardiopulmonary disease acute care admission were the availability of primary care physicians and the mean number of home health visits per county. This pilot study suggested that differences do exist between counties in the admission rates for chronic obstructive pulmonary disease and heart failure and shock and that social determinant variables could help explain the difference in admission rates.

Utilization of Healthcare Services

The national readmission rate for heart failure within 30 days after hospital discharge is 17.2% (Cardiology Pre-eminence Roundtable, 1994). Considerable research is ongoing to identify a suitable outcome variable to measure the effectiveness of heart failure interventions, and to characterize the persons with heart failure at greatest risk of experiencing negative health outcomes. Negative health outcomes in persons with heart failure have been directly measured using individual physical, functional, or psychological attributes of health, or indirectly measured by calculating hospital readmission rates as a proxy variable for negative health outcomes.

At the individual level, outcome assessments for patients with heart failure in studies have primarily focused on individual clinical, rather than intermediate outcomes. Clinical outcomes included mortality, functionality, or symptom status. Intermediate outcomes are individual-based indicators that can be biochemical, physiological, anatomical, or histological (Hadorn, Baker, Dracup, & Pitt, 1994). Examples of common physiological indicators for heart

failure include left ventricular ejection fraction or heart size (Franciosa, 1987; Hadorn et al.). While clinicians are still most comfortable using intermediate outcomes, it is important to recognize that changes in these variables did not appear to correspond with changes in prognosis (Hadorn et al.). Intermediate outcomes have not been found to be valid predictors of clinical outcomes such as mortality, functionality, or symptom status (Hadorn et al.).

Although some version of readmission rates was the most common outcome measure utilized in the majority of studies, numerous other variables have been measured. Clinical outcomes described in the literature include mortality rates (CONSENSUS Trial Study Group, 1987; Garnick, DeLong, & Luft, 1995; The SOLVD Investigators, 1991; Wolinsky, Overhage, et al., 1997); premature mortality before age 65 (Cohen & MacWilliam, 1995); risk-adjusted mortality rates using severity-of-illness measures (Iezzoni et al., 1995) or comorbidity (Charlson et al., 1987); hospital readmission for any reason (Alexy, Elnitsky, & Nichols, 1996; Brooten, Naylor, Brown, et al., 1996; Happ, Naylor, & Roe-Prior, 1997); early readmission rates (Ashton et al., 1995; Chin & Goldman, 1997; Hofer & Hayward, 1995; Vinson et al., 1990); disease specific readmission (Gooding & Jette, 1985); and psychological, psychosocial, and functional quality of life measures (Dracup, Moser, Marsden, Taylor, & Guzy, 1991; Dracup, Walden, Stevenson, & Brecht, 1992; Guyatt et al., 1989; Moser & Dracup, 1995; Rideout & Montemuro, 1986; Tandon, Stander, & Schwarz, 1989; Walden et al., 1994).

32

Mortality Rates

Mortality was a common clinical outcome measure utilized in studies. Mortality events are measured using different time periods and were often adjusted for severity of illness or comorbid conditions. No consensus was identified regarding an ideal time period for the measurement of mortality for patients with heart failure. Time frames for mortality occurrence included shorter evaluation periods of 30 and 180 days, and longer periods of one and eight years. Garnick et al. (1995) found no differences in the 30-day versus 180-day postadmission hospital mortality rates for patients with heart failure treated in hospitals categorized by hospital performance measures. The CONSENSUS trial (1987) followed patients for six months with a 40 percent reduction in mortality in the group treated with angiotensin-converting enzyme inhibitors. Wolinsky, Overhage, et al. (1997) examined mortality rates of 7,286 adults aged 70 years and older who were hospitalized for heart failure over an eight year period and found 1- and 8-year mortality rates were 34.7% and 69.0%, respectively.

Premature mortality rates before age 65. Another approach to measuring mortality events was the examination of premature mortality, defined as deaths in persons 0 to 64 years of age (Cohen & MacWilliam, 1995). Premature mortality rate was positively related to overall mortality rates and was found to be the most sensitive indicator of the population health status. Premature mortality was positively correlated to the overall

33

incidence of heart failure in the study population of Manitoba residents. Premature mortality rates reflected the existence of a social gradient where mortality rates increased as social class status decreased. Also associated with the increased premature mortality rates were decreasing quality of life measures, including increased morbidities, disability, discomfort, and dissatisfaction with health status (Cohen & MacWilliam).

Severity measures. Iezzoni et al. (1995) examined the reliability of illness severity scoring to risk-adjust mortality rates for cardiac patients. Using four severity measures, the retrospective cohort study scored severity of illness, defined as risk for in-hospital death, for 11,880 adults being managed medically for treatment of acute myocardial infarction. The four severity measures included two measures; Disease Staging and the All Patient Refined Diagnosis Related Groups, which used data obtained from standard hospital discharge abstracts, including patient age, sex, and diagnoses and procedures coded using the International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM). The other two measures; MedisGroups and Physiology score, used clinical data abstracted from the medical records for the first two days of hospitalization. The four scores were then compared to actual mortality outcomes. Study results indicated that some pairs of severity measures assigned very different severity levels to more than 20% of patients. Patients were generally viewed as sicker by the discharge abstract-based measures such as the Disease Staging tool or the

34

All Patient Refined Diagnosis Related Groups tool, than by the clinical data-based measures such as the MedisGroups or Physiology score patterned after the Acute Physiology and Chronic Health Evaluation III (Knaus, Wagner, Zimmerman, & Draper, 1993). In terms of mortality, the patients viewed as sicker by the discharge abstract-based measures had higher mortality rates than those patients viewed as sicker by the clinical data-based measures. In summary, the discharge abstract-based measures had better predictive validity, but the clinical data-based measures had better clinical validity. The literature remains unclear as to which severity measure provided the greatest overall validity in risk-adjusting mortality rates for cardiac patients.

Comorbidity. Another aspect of mortality measurement is the possible confounding effect of comorbidity on mortality rates. The Charlson Comorbidity Index was developed to classify comorbid conditions that might alter the mortality risk in longitudinal studies (Charlson et al., 1987). In the subsequent psychometric evaluations of the Charlson Comorbidity Index using different populations, the index score was found to be reliably predictive of one year mortality (Charlson, Szatrowski, Peterson, & Gold, 1994; Covinsky, Justice, Rosenthal, Palmer, & Landefeld, 1997; Pompei, Charlson, MacKenzie, & Norton, 1991). In one study examining the correlates of early hospital readmission or death in patients with heart failure, higher Charlson Comorbidity Index scores were positively correlated to both of the endpoints of readmission and/or death within 60 days of hospital discharge (Chin &

Goldman, 1997). No other comorbidity measures to risk-adjust mortality rates for persons with heart failure were identified in the literature.

In summary, mortality rates provided an objective clinical outcome measure. Mortality does not; however, provide a useful measure of the effectiveness of treatment or other healthcare interventions (Hadorn et al., 1994). No consensus in the literature was identified regarding an ideal time period for the measurement of mortality events for patients with heart failure. Severity-of-illness and comorbidity measures have been developed to risk-adjust mortality rates. The literature remains unclear as to which severity measure provides the greatest overall validity in risk-adjusting mortality rates for cardiac patients. One year mortality risk has been successfully modeled using the Charlson Comorbidity Index in patients with heart failure, as well as with other populations. No other comorbidity measures to risk-adjust mortality rates for persons with heart failure were identified in the literature.

Quality of Life

Quality of life measures utilized in various studies included psychological/psychological measures, and combined psychological and functional measures. Those measures were frequently combined within studies.

Psychological/psychosocial. Three studies evaluated the effectiveness of interventions using psychological or psychosocial outcome measures. Moser and Dracup (1995) examined the psychosocial recovery from a cardiac

36

event using the Multiple Affect Adjective Checklist and the Psychosocial

Adjustment to Illness Scale. Significant differences were found between the

psychosocial recovery of patients with feelings of high control versus low

control post-myocardial infarction or coronary artery bypass surgery. Patients

with perceived high control were less anxious, less depressed, less hostile,

and had better psychosocial adjustment at a six month follow-up visit than

those patients with perceived low control. Dracup, Moser, et al., (1991)

examined the impact of a cardiac rehabilitation program on psychological

function measured with the previously mentioned instruments and the Spanier

Dyadic Adjustment Scale to measure marital adjustment. Significant

differences were found between the treatment and control groups. Patients

who attended cardiac rehabilitation programs were significantly less anxious,

less depressed, had better psychcosocial adjustment and were more satisfied

with their marriages. Finally, Rideout and Montemuro (1986) examined the

relationship between hope, morale, the level of function, and physiological

status of subjects with heart failure. Patients who scored higher on the scales

assessing hope and morale also scored higher on social function. No

significant results were found with the small study sample ($\underline{n}$ = 23).

    Combined Psychological and Functional Measures. Three studies

combined psychological and functional outcomes to measure quality of life

(Dracup, Walden, et al., 1992; Guyatt et al., 1989; Tandon et al., 1989). Each

of these studies used a combination of physiologic measurements, such as

the six minute walk test (Guyatt et al., 1985; Guyatt, 1987), and surveys to assess psychological or psychosocial functioning.

Dracup, Walden, et al. (1992) evaluated the relationship between quality of life measures and psychosocial adjustment in 134 subjects with symptoms of chronic heart failure. Quality of life was examined using functional capabilities measured by the Heart Failure Functional Status Inventory, the Six-minute Walk Test; symptom assessment using the New York Heart Association (NYHA) class, and the Heart Failure Functional Status Inventory; and psychosocial perceptions using the Multiple Affect Adjective Checklist and the Psychosocial Adaptation to Illness Scale. Severity of illness was measured using intermediate indicators of New York Heart Association (NYHA) functional classifications, the results of the six minute walk test, and the metabolic equivalent level assigned in the Heart Failure Functional Status Inventory. The NYHA functional classifications separated patients with heart failure into four categories: class I, unlimited activity without clinical symptoms; class II, ordinary physical activity causes fatigue, dyspnea, palpitation, or angina pectoris; class III, marked limitation of activity and symptoms with less-than-ordinary activity, but no symptoms at rest; and class IV; any physical activity is accompanied by symptoms, and symptoms occur at rest. The six minute walk test measured the distance walked in six minutes. Dracup, Walden, et al. found no significant relationship between patient's cardiac ejection fraction and any quality-of-life measures; however, the results

38

of a 6-minute walk test, the New York Heart Association classification, and self-reported functional status were all significantly correlated with the three affective states of anxiety, depression, and hostility. The metabolic equivalent of the task (MET) level, depression, and hostility accounted for 43% of the variance in total psychosocial adjustment. The remaining three variables of NYHA class, six minute walk test, and anxiety explained only an additional one percent of the variance.

Guyatt et al. (1989) studied the relationship between the Chronic Heart Failure Questionnaire and functional status indicators, such as the 6-minute walk test; and clinical indicators, such as dyspnea. The 16-item Chronic Heart Failure Questionnaire, which examined dyspnea during daily activities, fatigue, and emotional function, was found to be moderately correlated with the patients' global ratings of improvement or deterioration, their 6-minute walk test scores, and clinical assessments of heart failure.

Tandon et al. (1989) evaluated four Quality of Life instruments in a randomized, double-blind study to determine which quality of life instruments reflected the differences of being in the treatment or placebo group. Two of the four instruments, the Patient's Self-rating Scale and the Spitzer's Quality of Life instrument, showed a significant difference between the treatment and placebo groups for an overall effect. Each of these three studies recommended use of multidimensional quality of life assessments as an outcome measure.

The use of combined psychological and functional measures appears to be supported in the literature for prospective studies at the individual level of analysis. In terms of functional measures, the strongest support exists for the six minute walk test described originally by Guyatt et al. (1985). There is no consensus in the literature about which quality of life questionnaire is most appropriate with heart failure patients.

Readmission Rates

Readmission rates for heart failure within the first 14 days to 1 year of discharge range from 2.9 to 47.5%, respectively. Experts believe the high rate of readmission is a system indicator of inadequate long-term management of heart failure (Rich et al., 1995). The relationship between hospital readmission rates and a variety of independent variables has been examined by numerous researchers. The independent variables of these studies included generalist versus specialist care; previous admission for heart failure; baseline ejection fraction; stress, coping, and social support; quality improvement initiatives; and discharge planning or case management integrating education, counseling, dietary and lipid management, and/or exercise training. Table 2 outlines the major findings of these studies.

One study examined home health care as the independent variable (Lazarre & Ax, 1997). Thirty four patients were admitted to home care following hospitalization for an acute exacerbation of heart failure. Home care services included targeted information on risk factors, disease

Table 2

Readmission Rates of Patients with Heart Failure

Author (Year)	Study Design	Sample Size	Independent Variable(s)	Type of Readmit	Study Period	Percent Readmit
Gooding & Jette (1985)	Retrospective cohort	n = 148	None	any	6 months	36
Rich & Freedland (1988)	Retrospective cohort	n = 410	DRG type	any	90 days	29
Vinson, Rich, et al. (1990)	Prospective cohort	n = 161	None	any	90 days	47 total, 23.6 HF*
Rich et al. (1993)	RCT**	n = 98	Multi-disciplinary teaching	any	90 days	33.3 - 45.7
Naylor et al. (1994)	RCT**	n = 142	Discharge planning	any	90 days	7 - 10
Ashton et al. (1995)	case-control	n = 748	Quality of care index	any	14 days	14.1
Rich, et al. (1995)	RCT**	n = 282	Multidiscipline intervention	any	90 days	28.9 - 42.1
Brooten, et al. (1996)	2° RCT** analysis	n = 142	Case management	any	90 days	28
Philbin et al. (1996)	RCT**	n = 1402	Quality Improvement	any	6 months	43.4 total, 23.6 HF*
Reitsma et al. (1996)	Retrospective cohort	n = 3090	Previous HF* admissions	HF	6 months	16 - 47.5
Venner & Seelbinder (1996)	prospective, quasi-experimental	n = 98	HF* clinical pathway	any	30 days	12.5 - 17.2
Chin & Goldman (1997)	Prospective cohort	n = 257	None	any	60 days	31.1
Fonarow et al. (1997)	Prospective cohort	n = 214	Medication & counseling	any	6 months	29.4
Happ, Naylor & Roe-Pnor (1997)	qualitative review	n = 16	None	any	6 months	50
Pernenkil et al. (1997)	Prospective cohort	n = 683	Ejection fraction	any	90 days	29.2 - 42.1
Reis et al. (1997)	Retrospective cohort	n = 298	Generalist v. specialist	HF	6 months	30.7 - 44.3
Krumholz et al. (1997)	Retrospective cohort	n = 17448	None	any	6 months	44 total, 18 HF*
Lazarre & Ax (1997)	Prospective cohort	n = 34	Home health care	any	30, 90 days	2.9, 8.8
Stewart et al. (1997)	Prospective cohort	n = 100	stress, coping, & social support	any	4 months	24
Wolinsky, Smith, et al. (1997)	Retrospective cohort	N = 1129	None	any	30, 60, 90 days, 1 yr.	16 - 47.5

*HF = heart failure, **RCT = randomized control trial

pathophysiology, symptom management, dietary management, fluid

restrictions, medications, and weight management. The services provided by

a multidisciplinary team including a nurse, home care aide, social worker, and/or a physical therapist were customized to the needs of the patient. (Lazarre & Ax). The results of this study demonstrated the lowest readmission rates of all identified studies. The 30 day readmission rate was 2.9% and the 90 readmission rate was 8.8%, compared to national averages of 17.2% and 32% percent, respectively, for the same time periods.

Mixed interpretations of what constituted the most valid measurement of readmission for heart failure were evident in the literature. While readmission rate was the most commonly used outcome measure, it remained unclear whether these rates should include readmission for DRG 127 or for any diagnosis. Additionally, the literature was vague as to the most clinically significant length of time to evaluate readmission. At present, the most common time frames used in studies were 3 and 6 months. A potential weakness of some retrospective studies was the use of site-specific medical records which may not have accurately reflected readmission rates if the patient received care elsewhere.

<div align="center">Summary</div>

More than 4.9 million Americans have heart failure (American Heart Association, 1998). Prevalence and incidence of heart failure continues to increase despite recent treatment innovations (Packer, 1996). Direct costs of care for persons with heart failure are expected to exceed $19.6 billion in 1999 (American Heart Association). Ongoing research is attempting to

understand the complex relationships at the individual and ecological levels between treatment and outcomes for persons with heart failure. Two primary issues emerge from the review of literature. First, there is no clear consensus about how to measure outcomes for persons with heart failure. Variability in heart failure prognosis has not been satisfactorily explained using intermediate outcome measures such as left ventricular ejection fraction. Intermediate outcomes have not been found to be valid predictors of clinical outcomes such as mortality, functionality, or symptom status (Hadorn et al., 1994).

Clinical outcome measures such as mortality and the six minute walk test (Guyatt, 1987) were useful in describing the individual treatment response and progression of the disease process, but have limited usefulness when studying populations of persons with heart failure, particularly in retrospective cohort studies. Additional concerns existed about the use of mortality as an outcome measure. Mortality as a terminal endpoint may be confounded by severity of illness and/or comorbidity. Mortality risk was adjusted in studies for both of these characteristics describing a person with heart failure. The literature was not clear; however, about the best approach to adjust for severity of illness. Iezzoni et al. (1995) recommended that the selection of a severity-of-illness instrument to adjust mortality risk should depend on the reasons for using mortality as an outcome variable. The

literature regarding adjusting mortality risk for comorbidity supported the use of the Charlson Comorbidity Index.

The most common outcome measure described in the literature was hospital readmission occurrence. The reasons for selection of readmission as an important outcome variable was related to the high risk of readmission for persons with heart failure, with readmission rates varying from 2.9 to 47.5% within 14 days to one year, respectively. A major advantage of using readmission rates is the ability to accurately measure this variable prospectively and retrospectively. The major concerns in the literature regarding use of readmission occurrence focused on whether to record readmission for DRG 127 or for all diagnoses, and for what time interval. No consensus was evident in the literature regarding diagnosis choice. The most common time intervals for measurement were 90 and 180 days.

A final concern regarding measurement of outcomes was related to selection of sample subjects. For the 20 studies (Table 2) using readmission rates as the selected outcome measure, no consistent approach was identified to manage the internal validity risk related to subject mortality. Nine of the 20 studies did not mention mortality. In three studies, subjects who died during the initial hospitalization were excluded from further analyses. Three studies reported the use of Cox proportional hazard regression modeling to assess the probability of survival without readmission during the designated time interval with the subjects' records censored upon death. One study

censored subjects' records for mortality during the data collection period. The remaining studies retained all subjects regardless of mortality and reported mortality rates, but did not report any adjustment for subject loss.

The second issue to emerge from the literature is the inadequate explanatory power of clinical factors to explain hospital readmission rates for persons with heart failure. Readmission rates varied from 2.9 to 47.5% within 14 days to 1 year, respectively. Heart failure incidence and prevalence continue to rise despite treatment innovations. Studies examining the effect of treatment modalities on readmission rates most frequently reported changes in readmission rates, but did not report findings about the proportion of variance explained by the treatment models.

A broader, more comprehensive approach is needed to understand the complex relationships between healthcare delivery systems and important outcomes for persons with heart failure. This complex relationship can be examined using the Framework to Study Access (Aday & Andersen, 1980). This access model integrates characteristics of the healthcare systems and the population-at-risk, and allows for the inclusion of both individual-level and ecological-level descriptors of the population-at-risk.

Individual level indicators of the population-at-risk for heart failure in Kansas elders focused on the key issues of rural residence and being elderly. Demographically, rural residents are older and poorer, have higher unemployment rates, less education, less health insurance coverage, and

report poorer perceived health. Rural residents may experience decreased access related to increased distance to hospital-based care and diminished access to primary care providers. Studies reported that an increased distance to the hospital provider was related to a decreased utilization of inpatient and outpatient hospital services, and an increased mortality rate (Holloway et al., 1990; Luft et al., 1990; Piette & Moos, 1996). Perceived absence of viable primary care alternatives was related to an increased use of emergency department services. In addition to acute hospital and primary care services, the use of long-term care and home health care services appeared to reduce readmission rates (Gooding & Jette, 1985; Lazarre & Ax, 1997). The studies were inconclusive regarding increased or decreased use of physician and hospital services by rural elders. Similarly, there were mixed results regarding insurance status and use of hospital services. One study did find that elderly individuals with Medicare supplemental insurance used prescription medications more often than elderly individuals without supplemental insurance.

The inclusion of ecological-level descriptors of the population with cardiovascular disease has demonstrated promising results over the past twenty years (Marmot, 1996; Marmot et al., 1996; Marmot, Bosma et al., 1997; Marmot, Ryff et al., Marks, 1997; Marmot, Rose et al., 1978). Marmot described a steep social gradient between cardiovascular disease and social class. Characteristics describing the differences in social class, social

determinants, have been separated into categories of socioeconomic status, social stability, and overall societal health (Singh et al., 1998). Further work is needed to determine which social determinants provide the greatest explanatory power is describing variability in hospital readmission for persons with heart failure.

In summary, characteristics describing health service availability and the population-at-risk combine to provide the richest description of access. To date, few studies focused on heart failure outcomes have examined readmission events in relation to this broader set of measures. Combining individual-level and ecological-level variables holds greater promise in explaining the variability in heart failure readmission.

CHAPTER III

Methodology

This study was a retrospective analysis of a cohort of subjects who were hospitalized for treatment of heart failure in 1995. The population included all Medicare enrollees age 65 years and older in the state of Kansas who were discharged with a hospital discharge coded DRG 127 during 1995. Subjects hospitalized between January 1 and December 31, 1995 were followed for a six month period, with data collection concluding June 30, 1996. Every subject was followed for a six month period following discharge from the index event hospitalization to record readmission events for (a) DRG 127 and for (b) any diagnosis. The mortality data related to these subjects was tracked for one year from the time of discharge from the index event hospitalization.

Sample

Inclusion and Exclusion Criteria

Individuals were included in this study if they met the following criteria: (a) had a hospital discharge diagnosis of DRG 127, (b) were enrolled in the Medicare A & B programs, and (c) were born by January 1, 1929. All individuals, regardless of gender, ethnicity, or location of residence after discharge from the index event hospitalization, meeting these criteria were included in the study. Individuals were excluded from the study if they died during the six month data collection period.

<u>Sample Size</u>

The study performed analyses at the individual-level and ecological-level of analysis. The sample size for each analysis will be reported separately.

<u>Individual-level.</u> 4,886 Medicare enrollees age 65 years and older were discharged with a hospital discharge diagnosis coded DRG 127 during 1995. Twenty seven percent (1,344) of the subjects in the initial data set died during the six month data collection period, and were excluded from the study. The sample for this study consisted of 3,543 subjects who met the inclusion criteria. The sample included 2,598 readmissions. A stratified sampling was used to group subjects into two categories depending upon the population density of the county of residence (see Appendix A). The county of residence for each subject was categorized as either a MSA or a non-MSA. The non-MSA sample had 2,200 subjects and the MSA sample had 1,343 subjects. Each of these groups had sufficient sample size to provide power of .80 to detect small population effects (n > 393, α = .05).

<u>Ecological-level.</u> The 3,543 subjects were aggregated into 61 county groupings corresponding to the county of residence of the subject or groups of Kansas counties containing the county of residence of the subject. Subjects residing in frontier counties comprised ten county groupings, subjects residing in rural counties comprised 24 county groupings, subjects residing in densely-settled rural counties comprised 18 county groupings, and

subjects residing in metropolitan statistical area counties comprised nine county groupings. Because 57 of the counties did not possess sufficient individual hospital admissions to provide sufficient statistical stability, these counties were grouped according to the study criteria for aggregation. The criteria used to group counties included (a) all counties remained within their population density designation of frontier, rural, densely-settled rural, and metropolitan statistical area, (b) the minimum county population age 65 years and older was at least 1,500 persons, (c) the minimum number of index hospitalizations represented in the county grouping was 20 events, (d) geographic proximity was maintained with a contiguous border, if possible; if not possible, the counties could only be separated by one intervening county of another population density category, and (e) similar patterns of patient flow toward regional hospitals existed, which were guided by EACH/RPCH networks, when possible. The final aggregated data set contained 61 county groupings, composed of one to five counties. Only three county groupings had more than three counties. The county grouping containing Chase and Elk counties violated the third criteria of having at least 20 events. This county grouping had only 19 events, but adherence to the remaining criteria was maintained. County grouping was required for all frontier counties (see Appendix B).

Data Sets

Individual Level Analysis

Table 3 outlines the specific variables and the sources of data used to examine research hypothesis one. Record level data for study subjects related to readmission, mortality, and skilled home care were obtained from the Medicare enrollment base data, the Medicare beneficiary enrollment file,

Table 3

Individual Level Variables

Variable Label	How is Defined	Source of Data
Dependent Variables:		
Readmission for any diagnosis	Incidence per index event measured at 30, 90, & 180 days	Medicare inpatient claims database
Readmission for DRG 127	Incidence per index event measured at 30, 90, & 180 days	Medicare inpatient claims database
Independent Causal Variables:		
Potential Access:		
Availability of emergency or community hospital	Distance from home to index hospitalization site	To be calculated from Medicare inpatient claims database
Availability of specialty medical care	County population ≥ 65 years per cardiologist	Office of Health Information
Availability of primary health care	County population ≥ 65 years per primary care MD or DO	Office of Health Information
	County population ≥ 65 years per nurse practitioner or physician assistant	Office of Health Information
Availability of emergency transportation	County population ≥ 65 years per staffed ambulance	Area Resource File
RPCH facility	Presence or absence of an rural primary care hospital (RPCH) in county of residence	Office of Rural Health
Dual eligibility	Dual eligibility	Medicare inpatient claims database
Realized Access:		
Home health care	Receipt of skilled home care within six month period	Medicare nursing facility claims file
Independent Control Variables:		
Potential Access		
Population density designation	Dummy variable for county designation as frontier, rural, densely-settled rural, or metropolitan statistical area (Appendix A)	Area Resource File
Death	Death occurs within one year of index event	Medicare beneficiary enrollment file
Charlson Comorbidity Index Score	Sums rankings ranging from 1 to 6 for subject comorbidities	To be calculated from Medicare inpatient claims database

and the Medicare nursing facility claims file. The data collected from individual Medicare Part B records included the DRG discharge diagnosis; comorbid inpatient ICD-9 diagnosis codes; recorded date of death, indication of Medicaid reimbursement for Part B claims which provided evidence of dual eligibility for Medicare and Medicaid; and demographic information about age, residence, and location of the hospitalization. Medicare Part A information provided data about whether the subjects received skilled home care. Only those Kansas residents age 65 years and older in 1995 who were enrolled in the Medicare program with a discharge diagnosis code of DRG 127 were included in this data set. The first discharge for heart failure beginning on January 1, 1995 was considered the index event and subjects were followed from that date for six months to record readmission events and for twelve months to record mortality events. Data were requested for all individuals meeting the inclusion criteria from January 1, 1995 until December 31, 1995. The number of readmissions at 30 days, 90 days, and 6 months were recorded. The collected data verified whether each patient was readmitted for any diagnosis or specifically for DRG 127. The receipt of skilled home care visits by licensed nurses and other care providers was also extracted for a six month period. Finally, the Medicare beneficiary enrollment file was examined to identify death events for one year after the index event for each subject.

The Medicare Part A and Part B data elements were merged with the data obtained from the Office of Health Care Information, Kansas Department of Health and Environment and the Area Resource File. Access variables were created to describe the availability of emergency and/or community hospitals, emergency transportation, and specialty and/or primary providers (including physicians, physician assistants, and nurse practitioners). Availability was defined by the distance in miles from the subjects' community residence to the site of the index event hospitalization. The county in which each subject resided was categorized according to population density into non-MSA (frontier, rural, and densely-settled rural) and MSA designations (see Appendix A).

Ecological-Level Analysis

To extend the understanding of access, an ecological analysis combined county level access variables and dependent variables reflecting county or grouped county hospital readmission rates to examine the relationship between heart failure outcomes and access (see Table 4). The data were obtained from the same data sets used in answering research hypothesis one. The access to skilled home care was defined as the percent of subjects per county cluster receiving skilled home care during the six month data collection period. The resultant transformed data set was merged with additional data on social and societal determinants obtained from the Area Resource File to create the final data set.

Table 4

Ecological Level Variables

Variable Label	How is Defined	Source of Data
Dependent Variable:		
Readmission for any diagnosis	Adjusted mean incidence per subject measured at 180 days per county grouping	Medicare inpatient claims database
Independent Causal Variables:		
Potential Access:		
Availability of emergency or community hospital	Mean distance from home to index hospitalization site per county	To be calculated using Medicare inpatient claims database
Availability of specialty medical care	County population ≥ 65 years per cardiologist	Office of Health Information
Availability of primary health care	County population ≥ 65 years per primary care MD or DO	Office of Health Information
	County population ≥ 65 years per nurse practitioner or physician assistant	Office of Health Information
Availability of emergency transportation	County population ≥ 65 years per staffed ambulance	Area Resource File
Social Determinants:		
Social stability	Percent single-parent households	Area Resource File
	Percent county population owning home	Area Resource File
	Percent county population age 16 and over unemployed	Area Resource File
Socioeconomic status	Median family income	Area Resource File
	Percent county population in poverty	Area Resource File
	Percent of persons over age 65 that are dually eligible for Medicare and Medicaid	Medicare beneficiary enrollment file
	Percent persons age 25 and older with 4+ years of college	Area Resource File
Societal health	Percent of students graduating high school	Area Resource File
	Violent crime rate per county population	Area Resource File
	Motor vehicle injuries per county population	Area Resource File
	Age-adjusted death rate per county population	Area Resource File
Realized Access:		
Home health care	Mean number of subjects receiving skilled home care in the six month period per county	Medicare nursing facility claims file
Independent Control Variables:		
% county population ≥ 65 years	County population ≥ 65 years/County population X 100	Area Resource File
Population density designation	Dummy variable of county designation as frontier, rural, densely-settled rural, or metropolitan statistical area (Appendix A)	Area Resource File

Data Retrieval

The data were obtained from pre-existing data sets. Proprietary data sets used for this study were obtained from the Kansas peer review organization, Kansas Foundation for Medical Care for Medicare Part A data; from the Iowa peer review organization, Wellmark Blue Cross and Blue Shield, for Medicare Part B data; and purchased from Quality Resource Systems for the Area Resource File. Public domain data was obtained from the Office of Health Care Information, Kansas Department of Health and Environment. Written requests to the Kansas Foundation for Medical Care and to Wellmark Blue Cross and Blue Shield specified the data elements to be extracted from the Medicare inpatient claims database, the Medicare beneficiary enrollment files, and the Medicare nursing facility claims files.

The Area Resource File was obtained from Quality Resource Systems with the permission from the Office of Research and Planning, Bureau of Health Professions, Health Resources and Services Administration. This file is a computerized data set pooled from more than 200 different data sources that contains time series information on a variety of socioeconomic, health, and health provider characteristics for every county in the United States. The approximately 6,500 variables available in the Area Resource File are categorized into four broad categories of (a) vital statistics, (b) sociodemographic and environmental data, (c) health facilities, and (d) health

professions. Variables from each of the four categories were utilized in this study.

Reliability and Validity

The reliability and validity issues inherent in using administrative data sets are well documented. The threats to reliability included inconsistent coding of medical and health information, as well as missing or inaccurate data elements. A strength of using Medicare discharge data from peer review organizations was the reduction of sample selection bias through acquisition of a complete history of all hospitalizations statewide. It is acknowledged that certain individuals with mild disease or those individuals resistant to attaining healthcare services were not represented in this sample.

The major validity issues of this study were related to the use of DRG 127 to categorize a broad set of disease events (Mittelmark et al., 1993). Research hypothesis one assumed admission and readmission events provided an unbiased estimate of the severity of the illness at the individual-level of analysis. Three problems were identified that may have impacted the validity of this assumption. First there was the well documented variation in physician readmission practices (Miller, Miller, Fireman, & Black, 1994; Wennberg & Gittelsohn, 1982). Next was the issue of patients having comorbid conditions that altered the admission rate for the treatment for heart failure. Finally, patient death during the data collection period altered the

readmission rate, reducing the time period in which readmission events could occur.

Physician practice pattern variation in readmissions. To detect urban-rural physician practice pattern variation, the individual-level analyses were performed using samples, which stratified subjects, by their category of residence, non-MSA or MSA (see Appendix A). Physician variation in readmission has been shown to be influenced by regional practices common to non-MSA or MSA counties (Wennberg & Gittelsohn, 1982). Stratifying the subjects also prevented the larger number of readmission events that occurred in MSA counties from dominating the individual-level analyses and masking possible relationships present in non-MSA counties. No adjustment was needed to reflect managed care differences in physician admissions since the data set being used reflected a time period during which, in Kansas, Medicare managed care plan products were not available to Medicare beneficiaries.

Comorbidity. The second problem potentially affecting the validity of index admission events as an unbiased estimate of disease severity was the presence of comorbidity. To control for this anticipated confounding factor, a Charlson Comorbidity Index score, calculated using the index hospitalization inpatient ICD-9 codes of each subject, was included as an independent variable. The Charlson Comorbidity Index is a weighted index that considers the number and the seriousness of comorbid diseases to determine the risk of

one-year mortality in longitudinal studies (Charlson et al., 1987; Pompei et al.,

1991). Table 5 outlines the assigned weights for comorbid conditions.

The Charlson Comorbidity Index score was calculated by summing the

weights identified by the ICD-9 codes for the index event hospitalization. All

subjects had, at a minimum, a Charlson Comorbidity Score of 1 to reflect the

ICD-9 code for heart failure. Additional comorbid conditions, weighted by the

appropriate disease-specific value, were added to the base score of 1 to

obtain a total Charlson Comorbidity Index score. For example, a subject with

the additional comorbidity of ulcer disease would have a Charlson

Comorbidity Index score of 2.

Table 5

Charlson Weighted Index of Comorbidity

Assigned weights for diseases	Conditions
1	Heart failure
	Myocardial infarction
	Peripheral vascular disease
	Cerebrovascular disease
	Dementia
	Chronic obstructive pulmonary disease
	Connective tissue disease
	Ulcer disease
	Mild liver disease
	Diabetes
2	Hemiplegia
	Moderate or severe renal disease
	Diabetes with end organ damage
	Any tumor
	Leukemia
	Lymphoma
3	Moderate or severe liver disease
6	Metastatic solid tumor
	AIDS

This study adopted a comorbidity stratification rule in the analyses separating subjects with a Charlson Comorbidity Index score of less than 2 (CMI = 1) and those with a score of greater or equal to 2 (CMI ≥ 2). The two stratified groups were analyzed separately examining (1) readmission events and (2) death events as the dependent variables for comparison. It was speculated that if the readmission rate was an accurate indication of disease severity, the relationship between the Charlson Comorbidity Index score and readmission events, and the relationship between Charlson Comorbidity Index score and death events would be similar in direction. Prior to including the Charlson Comorbidity Index score as a covariate, the homogeneity of slopes assumption was tested in the initial analysis of variance. The homogeneity of slopes assumption was violated, therefore negating the use of the Charlson Comorbidity Index score as a covariate. Instead the Charlson score was added to each analysis to assess for interaction effects with the independent variables. If a significant interaction was found, the analysis was stratified by comorbidity category before further analysis was performed.

Mortality. Another validity threat was the differential loss of subjects due to death-related attrition. This threat was addressed using two approaches at the individual level of analysis. In the first approach, the stratified samples were analyzed after censoring the records of subjects who died during the six month data collection period for readmission events. In the second approach, the records of the subjects who died within six months

were not censored and remained in the stratified samples. In the second approach, a control variable was included in the analyses to describe the number of days the subject survived during the six month data collection period. The findings of regression analyses between the two sets of samples were then compared for similarities and differences. At the ecological level, the records of subjects who died during the six month data collection period for readmission events were censored prior to the aggregation into county groupings.

Data Management

The data entry and data management functions were performed by the investigator. Raw data was entered as machine readable data files useable for reporting and data analysis and then cleaned, with newly calculated data added later. The data was analyzed using SPSS software. The computer diskettes and CD-ROMs containing raw data were stored in a locked drawer. No identifying names were attached to the subject data. The raw data will be destroyed at the completion of the study.

Statistical Analysis

Individual Level

Descriptive statistics of the total sample were calculated, and then the sample was stratified by MSA/non-MSA population density criteria and descriptive statistics for the stratified samples were calculated. No data were missing. All subsequent analyses were performed using the two stratified

samples. The relationships between the dependent variables of readmission for any cause, readmission for DRG 127; and the independent causal variables describing access were examined using Pearson product-moment correlation coefficients. The independent variables included distance to index hospitalization, availability of rural primary care hospitals, population over age 65 years per ambulance, specialty and primary providers (including physicians, physician assistants, and nurse practitioners); and the presence or absence of skilled home care or dual eligibility status during the six month data collection period.

Analyses of variance were performed to examine the relationship between readmission and comorbidity using each of the following continuous dependent variables: (a) readmission frequency for any cause per index event at 30 days, 90 days and 180 days, and (b) readmission frequency for DRG 127 per index event at 30 days, 90 days, and 180 days. Additional analyses of variances examined the relationship between the comorbidity and the twelve month mortality rate. A final set of higher way analyses of variances examined the relationships between the number of readmissions for any diagnosis within six months and the variables significantly correlated with readmission, including sex, skilled home care, dual eligibility status, and the Charlson Comorbidity Index score, as well as the interactions between these independent variables.

Regression analyses were then conducted to model the predictability of heart failure readmission from the significantly correlated variables of sex, skilled home care, dual eligibility status, and the Charlson Comorbidity Index score. Linear regression analyses were performed to determine the variance explained by the predictive models. Prior to the logistic regression analyses, readmission occurrence was categorized for each subject as (a) no readmissions for any diagnosis within 180 days, or (b) one or more readmissions for any diagnosis within 180 days.

Additional linear and logistic regression analyses were performed to examine the relationships between readmission for any diagnosis within 180 days and the independent causal and control variables when the censored subjects' records were included in the non-MSA and MSA samples. The number of days the subject survived during the six month data collection period was included in the linear and logistic regression analyses to control for the possible decrease in readmission occurrence due to mortality.

Ecological Level Analyses

The relationships between the dependent variable of the percent of subjects with at least one readmission for any diagnosis and the independent causal variables describing access were examined using Pearson product-moment correlation coefficients. The access variables that significantly correlated with the readmission rate at the $p < .002$ level were included in the regression models. Linear regression analyses were performed to determine

the variance explained by the predictive models. Logistic regression analyses were conducted to model the predictability of at least one readmission for any diagnosis within six months from the access variables. The predicted values obtained from the logistic regression analysis were examined to identify county groupings with high and low probability of residents experiencing at least one readmission for any diagnosis within six months.

Ethical Considerations

This study included all women and minorities in the sample who met the inclusion and exclusion criteria. The study was approved with exempt status from the University of Kansas Medical Center Institutional Review Board. The investigator kept secure in a locked desk all research related records and information utilized in this study, and access to the data files was restricted to the investigator. The identity of subjects will not be revealed in publications. All records will be destroyed at the conclusion of the study.

CHAPTER IV

Results

The purpose of this study was to determine the relationship between access to healthcare services and heart failure outcomes. Two levels of analysis were performed to examine this relationship. Research hypothesis one examined the relationship between readmission and access. This hypothesis was examined at an individual-level of analysis with a stratified sampling based upon the population density of the county of residence categorized as a metropolitan statistical area or non-metropolitan statistical area (MSA/non-MSA). Research hypothesis two examined additional relationships between readmission and access by including county level social determinants of health. Research hypothesis two was examined at an ecological-level of analysis using county groupings as the level of measurement. The findings of the study are presented in this chapter with the results separately reported for the individual and the ecological level analyses.

<u>Individual Level Population Characteristics</u>

<u>Description of the Sample</u>

In Kansas, 4,886 Medicare enrollees age 65 years and older were discharged with a hospital discharge diagnosis coded DRG 127 during 1995. Twenty seven percent (1,344) of the subjects in the initial data set died during the six months data collection period, thus necessitating exclusion from the

study. The sample for this study consisted of 3,543 subjects who met the inclusion criteria. The demographic variables examined included age, sex, distribution by county and the population density type, and the Charlson Comorbidity Index of the sample. Descriptive statistics will describe both the sample as a whole and the two stratified population samples, MSA and non-MSA.

Total sample. Study subjects ranged in age from 65 to 101 years, with a mean age of 79.5 years ($\underline{SD}$ =7.63). The sample consisted of 1,407 men (39.7%) and 2,136 women (60.3%). The county of residence for the sample spanned all 105 Kansas counties. The mean Charlson Comorbidity Index (CMI) score for the sample ranged from 1 to 9, with a mean score of 1.83 ($\underline{SD}$ = .99). Further examination of the Charlson Comorbidity Index scores of sample subjects separating the two categories; those subjects with heart failure as the only morbid condition (CMI = 1), and those subjects with heart failure with additional comorbidities (CMI $\geq$ 2). 1,698 (47.9%) subjects had a CMI score of 1, and 1,845 (52.1%) subjects had a CMI score of greater than or equal to 2.

Stratified samples. Subjects residing in non-MSA counties ranged in age from 65 to 100 years with a mean age of 79.8 years ($\underline{SD}$ = 7.59). As shown in Table 6, the subjects residing in MSA counties were slightly younger with a similar age range of 65 to 101 years and a mean age of 79.0 years ($\underline{SD}$ = 7.66). The fewest subjects lived in frontier counties, (N = 295), followed by

Table 6

Frequencies and Percentages by Sex For Total and Stratified Samples

	Frequency	Percentage
Total		
Male	1,407	39.7
Female	2,136	60.3
Non-MSA		
Male	900	37.8
Female	1,300	59.1
MSA		
Male	507	40.9
Female	836	62.2

those residing in rural counties (N = 889), and the most resided in densely-settled rural counties (N = 1016). The subjects in the non-MSA sample resided in all three county population density categories included in the non-MSA designation (see Table 7). The Charlson Comorbidity Index scores for subjects in the non-MSA sample ranged from 1 to 8 with a mean score of 1.77 ($\underline{SD}$ = .94). The Charlson Comorbidity Index scores for the MSA sample ranged from 1 to 9 with a mean score of 1.91 ($\underline{SD}$ = 1.06). The subjects in the MSA sample experienced significantly more comorbid conditions at the index hospitalization than subjects in the non-MSA sample, $\underline{F}$ (1, 3541) = 17.49, $\underline{p}$ = .00 (see Table 8).

Table 7

Frequencies and Percentages of Subjects by Population Density Category

	Frequency	Percentage
Non-MSA		
Frontier	295	8.3
Rural	889	25.1
Densely-settled rural	1,016	28.7
Total	2,200	62.1
MSA	1,343	37.9

Table 8

Frequencies and Percentages of Charlson Comorbidity Index Categories

	Frequency	Percentage
Non-MSA		
CMI = 1	1,087	49.4
CMI $\geq$ 2	1,113	50.6
MSA		
CMI = 1	611	45.5
CMI $\geq$ 2	732	54.2

Description of Readmission, Mortality, and Access

Readmission rates. The first research hypothesis examined whether increased access to healthcare services decreased the frequency of hospital readmission for elderly patients with heart failure over a six month period. Subjects were selected on the basis of an initial hospital discharge diagnosis of DRG 127 and survival for the entire six month data collection period. Readmission events included either readmission for DRG 127 or readmission for any diagnosis with the readmission occurrence recorded at three time intervals over the study period: 0 to 30 days, 0 to 90 days, and 0 to 180 days (see Table 9). Readmission rates for DRG 127 for the sample ranged from 0 to 6 readmissions over the six month data collection period, with 598 of the 3,543 (16.9%) subjects being readmitted at least once for DRG 127.

Table 9

Frequencies and Percentages of Subjects with At Least One Readmission by Stratified Sample

	0 – 30 days	0 – 90 days	0 –180 days
Non-MSA			
DRG 127	112 (5.1)	262 (11.9)	380 (17.3)
Any DRG	372 (16.9)	715 (32.5)	983 (44.7)
MSA			
DRG 127	58 (4.3)	140 (10.4)	218 (16.2)
Any DRG	184 (13.7)	371 (27.6)	544 (40.5)

Readmission rates for any diagnosis for the sample ranged from 0 to 9 readmissions, with 1,527 of the 3,543 (43.1%) subjects being readmitted at least once for any diagnosis. An examination of readmission for DRG 127 or for any DRG at 30, 90, and 180 days indicated that a greater percentage of subjects living in non-MSA counties were readmitted than subjects living in MSA counties.

Charlson Comorbidity Index. One-way analyses of variance were calculated within the stratified samples to examine the relationship of comorbidity and readmission frequency (see Tables 10 and 11). Subjects

Table 10

Differences in Readmission Frequency by Comorbidity Category Among Non-MSA Subjects

Readmission Frequency	Results of Analysis of Variance
DRG 127	
0 – 30 days	$F(1, 2198) = .59$, $p = .44$
0 – 90 days	$F(1, 2198) = 1.48$, $p = .22$
0 – 180 days	$F(1, 2198) = 2.72$, $p = .10$
Any DRG	
0 – 30 days	$F(1, 2198) = 3.40$, $p = .07$
0 – 90 days	*$F(1, 2198) = 6.28$, $p = .012$
0 – 180 days	*$F(1, 2198) = 13.56$, $p = .000$

* $p < .05$

Table 11

Differences in Readmission Frequency by Comorbidity Category Among MSA

Subjects

Readmission Frequency	Results of Analysis of Variance
DRG 127	
0 – 30 days	F (1, 2198) = .59, p = .44
0 – 90 days	F (1, 2198) = 1.48, p = .22
0 – 180 days	F (1, 2198) = 2.72, p = .10
Any DRG	
0 – 30 days	F (1, 2198) = 3.40, p = .07
0 – 90 days	*F (1, 2198) = 6.28, p = .012
0 – 180 days	*F (1, 2198) = 13.56, p = .000

* p < .05

were assigned to one of two categories; those whose only diagnosis was

heart failure or those who had additional comorbid conditions at the initial

hospitalization. The relationship between readmission frequency for DRG 127

or for any diagnosis was examined at 0 – 30 days, 0 – 90 days, and 0 – 180

days. For non-MSA and MSA samples, there were no significant differences

between readmission for DRG 127 for any time interval, or for readmission for

any diagnosis for 0 – 30 days. There were significant differences for subjects

readmitted for any diagnosis for the 0 – 90 days and 0 – 180 days time

intervals. Subjects in both stratified samples with increased comorbidities had

significantly more readmissions for any cause at 90 and 180 days. Since the greatest variability occurred when the readmission frequency was measured using any diagnosis for 0 – 180 days, the remaining analyses conducted to answer research hypothesis one used the six month readmission frequency for any diagnosis as the dependent variable with the inclusion of the Charlson Comorbidity Index categorical score to control for possible confounding influence.

Mortality. Twelve month mortality frequencies were calculated for the sample and then examined by stratified samples. It is important to note that the twelve month mortality in this sample actually reflected mortality in the second six months of the mortality data collection period. The records of the subjects who died during the first six months of data collection had been previously censored. The mortality incidence among the 3,543 subjects was tracked for twelve months after the initial hospitalization. 517 of the 3,543 (14.6%) subjects died between six and twelve months after the index event hospitalization. Table 12 reports the mortality frequencies. A two-way

Table 12

Frequencies and Percentages of Six to Twelve Month Mortality by Stratified Sample

Sample	Frequency	Percentage
Non-MSA (n = 2200)	318	14.5
MSA (n = 1343)	199	14.8

contingency table analysis calculated to evaluate differences in the six to twelve month mortality rates between non-MSA and MSA subjects found no differences, (Pearson χ^2(1, $\underline{N}$ = 3543) = .09, $\underline{p}$ = .77). Two-way contingency table analyses were calculated on the stratified samples to examine the relationship between comorbidity and six to twelve month mortality rates. Subjects were assigned to one of two categories; those whose only diagnosis was heart failure or those who had additional comorbid conditions at the initial hospitalization (see Table 13).

Table 13

Frequencies and Percentages of Six to Twelve Month Mortality by Charlson Comorbidity Categories Within Stratified Samples

	Frequency	Percentages
Non-MSA		
CMI = 1	120	37.7
CMI $\geq$ 2	198	62.3
MSA		
CMI = 1	78	39.2
CMI $\geq$ 2	121	60.8

The relationship between six to twelve month mortality rates and comorbidity was significant for non-MSA subjects, (Pearson χ^2(1, $\underline{N}$ = 2200) = 20.26, $\underline{p}$ = .00), and for MSA subjects, (Pearson χ^2(1, $\underline{N}$ = 1343) = 3.45, $\underline{p}$ = .05). In both

stratified samples, subjects with increased comorbidities died more frequently within twelve months of the index hospitalization.

Access. The stratified samples were examined to describe the access variables (see Table 14). The access variables selected included distance to index hospitalization; availability of cardiologists, primary care physicians, mid-level practitioners, emergency transportation, and rural primary care hospitals; dual eligibility status; and use of skilled home care. Table 14 provides a summary of the means, standard deviations, and ranges for these variables. In terms of access to care, non-MSA subjects had longer distances to index hospitalization sites, increased population per specialty or primary care provider, increased population per ambulance, a decreased percentage of population with dual eligibility or receiving skilled home care. 12.1 percent of the non-MSA subjects resided in counties containing a rural primary care hospital.

Testing the Relationship between Readmission and Access

Hypothesis 1, increased access to healthcare services decreases the frequency of hospital readmission for elderly patients with heart failure over a six month period, was not supported. Pearson product-moment correlation coefficients were calculated between each of the eight access variables and the six month readmission frequency for any diagnosis for the stratified samples (see Table 15). Using the Bonferroni approach to control for Type I error across the eight correlations, a p-value of less than .006 (05/8 = .006)

73

was required for significance. For non-MSA subjects, a significant positive

relationship was found between the six month readmission frequency for any

Table 14

Mean and Standard Deviations for Selected Access Variables

Variables	Non-MSA		MSA	
	M (SD)	Range	M (SD)	Range
Hospital distance in miles	13.93 (20.57)	1 – 217	8.97 (4.40)	1 – 249
County population ≥ 65 per cardiologist	-	-	2,777 (2,725)	1,295 – 13,275
County population ≥ 65 per primary physician	415 (440)	130 – 7,181	223 (105)	135 – 482
County population ≥ 65 per midlevel practitioner	597 (488)	104 – 4,070	322 (229)	132 – 775
County population ≥ 65 per ambulance	616 (299)	75 – 1,500	1,218 (436)	482 – 1,862
Percent having RPCH in county of residence	12.1	--	0.0	--
Percent dually eligible	17.32	--	14.65	--
Percent receiving skilled home care	27.77	--	33.34	--

Note. Single dash indicates the mean was not calculated because of the lack of cardiologists

in many non-MSA counties. Double dashes indicate the variables, percent having RPCH in

county of residence, percent having dual eligibility status, and percent receiving skilled home

care are categorical variables with a range of 0 to 1.

Table 15

Correlations Between Access Variables and Six Month Readmission for Any Diagnosis

Access Elements	Correlations between each predictor and six month readmissions	Partial correlations between each predictor and six month readmissions controlling for comorbidity
Non-MSA		
Sex	-.08**	-.06**
Distance to index events	-.01	-.03
County population ≥ 65 years per cardiologist	.00	.00
County population ≥ 65 years per primary physician	-.01	-.01
County population ≥ 65 years per midlevel practitioner	-.02	.01
County population ≥ 65 years per ambulance	-.02	-.01
Availability of RPCH	-.03	-.02
Dual eligibility	.05	.04
Skilled home care	.18**	.18**
MSA		
Sex	.04	-.07
Distance to index events	-.02	-.02
County population ≥ 65 years per cardiologist	-.01	-.01
County population ≥ 65 years per primary physician	-.04	-.04
County population ≥ 65 years per midlevel practitioner	.07*	.06*
County population ≥ 65 years per ambulance	-.05*	-.06*
Availability of RPCH	-.02	-.02
Dual eligibility	.11**	.10**
Skilled home care	.16**	.15**

* $p < .05$, ** $p < .006$

diagnosis and the receipt of skilled home care. A significant relationship was found between a decreased six month readmission frequency and being female. For MSA subjects, a significant positive relationship was found between the six month readmission rate and (a) the receipt of skilled home care and (b) having dual eligibility status.

Comorbidity effects. To control for the possible confounding effect of comorbidity, a two-way analysis of covariance (ANCOVA) was calculated for both stratified samples to examine the differences in the six month readmission rate for any diagnosis for subjects who had dual eligibility status or received skilled home care. Prior to calculating the ANCOVA, the homogeneity of slopes assumption was tested for both stratified samples to evaluate the interaction between the covariate and the two factors of receipt of skilled home care and dual eligibility status. A significant interaction was found between the Charlson Comorbidity Index and the receipt of skilled home care for the non-MSA sample, F (1, 2194), p = .01; thereby invalidating the use of the Charlson Comorbidity Index category as a covariate.

Interaction and main effects. To examine all access variables significantly correlated with the six month readmission rate, a 4-factor analysis of variance was calculated for each of the stratified samples to determine the effects of the Charlson comorbidity category, sex, receipt of skilled home care, and dual eligibility on the six month readmission rate for any diagnosis.

For non-MSA subjects, no significant interaction was found between sex and any combination of the other three factors. No significant interaction was found between the Charlson category, the receipt of skilled home care, and dual eligibility status, F (1, 2184) = 3.73, p = .06; the Charlson category and receipt of skilled home care, F (1, 2184) = .04, p = .85; or between receipt of skilled home care and dual eligibility, F (1, 2184) = 2.56, p = .11. A significant interaction effect was found between the Charlson category and dual eligibility status, F (1, 2184), p = .03. Significant main effects were found between the six month readmission rate and being male or female, F (1, 2184) = 9.05, p = .00; and between the six month readmission rate and the receipt of skilled home care, F (1, 2184) = 46.74, p = .00.

For MSA subjects, no significant interaction was found between sex and any combination of the other three factors, and no significant main effect was found between sex and the six month readmission rate, F (1, 1327) = .05, p = .82. Sex was then removed from the analysis and a second higher way analysis was calculated between the Charlson comorbidity category, receipt of skilled home care, and dual eligibility status on the six month readmission rate for any diagnosis. No significant interactions were found between the three factors, F (1, 1337) = 2.79, p = .10; between the Charlson category and the receipt of skilled home care, F (1, 1337) = .1.29, p = .26; or between the receipt of skilled home care and dual eligibility status, F (1,1337) = 1.25, p = .26. A significant interaction was found between the Charlson

category and dual eligibility status, F (1, 1337) = 5.24, p = .02. Significant

main effects were found between the six month readmission rate and the

receipt of skilled home care, F (1, 1337) = 7.76, p = .00, and between the six

month readmission rate and dual eligibility status, F (1, 1337) = 5.80, p = .02.

Examination of simple main effects within comorbidity categories. Non-

MSA and MSA subjects were then examined to determine the effect of

comorbidity on the relationship between six month readmission for any

diagnosis and the receipt of skilled home care and/or dual eligibility status

(see Tables 16 and 17). Subjects in each sample were assigned to one

Table 16

Six Month Readmission Rates for Non-MSA Subjects

Charlson Category	Skilled home care	Eligibility	Mean, SD
CMI = 1	Received care	No dual eligibility	.84 (.98)
		Dual eligibility	1.46 (1.26)
	No care	No dual eligibility	.59 (.98)
		Dual eligibility	.74 (1.05)
CMI = 2	Received care	No dual eligibility	1.24 (1.38)
		Dual eligibility	1.33 (1.32)
	No care	No dual eligibility	.66 (1.04)
		Dual eligibility	.77 (1.13)

Table 17

Six Month Readmission Rates for MSA Subjects

Charlson Category	Skilled home care	Eligibility	Mean, SD
CMI = 1	Received care	No dual eligibility	.82 (1.13)
		Dual eligibility	.57 (.94)
	No care	No dual eligibility	.41 (.80)
		Dual eligibility	.68 (1.17)
CMI = 2	Received care	No dual eligibility	.89 (1.09)
		Dual eligibility	1.38 (1.21)
	No care	No dual eligibility	.57 (.90)
		Dual eligibility	.96 (1.43)

of two groups, those having a Charlson Comorbidity Index score of 1, or a Charlson Comorbidity Index score greater than or equal to 2.

A two-way analysis of variance was then calculated within each comorbidity category to determine the relationship between the six month readmission rate for any diagnosis and the independent variables, skilled home care and dual eligibility status. For non-MSA subjects with a Charlson Comorbidity Index score of 1; a significant interaction was found between receipt of skilled home care and dual eligibility status, $F (2, 1083) = 4.33$, $p = .04$, partial $\eta^2 = .01$; and significant relationships were found between the readmission rate and the receipt of skilled home care, $F (1, 1083) = 18.45$, p

= .00, partial η^2 =.02; and between the readmission rate and dual eligibility status, F (1,1083) = 11.70, p = .001, partial η^2 =.01. For subjects receiving skilled home care, dual eligibility status was associated with the six month readmission rate. For subjects not receiving skilled home care, dual eligibility status did not significantly change the six month readmission rate. Receipt of skilled home care and dual eligibility status explained 2.5 percent of the variance.

Since the interaction between skilled home care and dual eligibility was significant for non-MSA subjects with a CMI = 1, the main effects for receipt of skilled home care and dual eligibility status were negated, and further calculations were performed to examine the simple main effects for skilled home care. To control for Type I error over the two pairwise comparisons, alpha was set at .025 (.05/2 = .025). For those subjects not receiving skilled home care, there were no significant differences in readmission rates based on dual eligibility status, F (1, 2,196) = 3.73, p = .05, partial η^2 = .002. For those subjects receiving skilled home care, significant differences were found in readmission rates for those who had dual eligibility, as compared to those subjects who did not, F (1, 2,196) =5.95, p = .02, partial η^2 = .03. In summary, non-MSA subjects with no other significant comorbidities that received skilled home care and had dual eligibility status had significantly more readmissions for heart failure than those subjects who did not have dual eligibility status. The direction of these findings does not support research hypothesis one.

For non-MSA subjects with a Charlson Comorbidity Index score of 2 or greater, a significant positive relationship was found between the six month readmission for any diagnosis and the receipt of skilled home care, F (1, 1109) = 31.54, p =.00, partial η^2 =.02. No significant relationships were found between the readmission rate and dual eligibility status, F (1,1109) = 1.01, p = .32, partial η^2 =.001; or between the receipt of skilled home care and dual eligibility status, F (2, 1109) = .005, p = .94, partial η^2 =.00. Receipt of skilled home care explained 4.8 percent of the variance. In summary, non-MSA subjects who had other comorbidities in addition to heart failure and received skilled home care had significantly more readmissions. These findings did not support research hypothesis one.

For MSA subjects with a Charlson Comorbidity Index score of 1, no significant relationships were found between six month readmission for any diagnosis and skilled home care, F (1, 607) = 1.11, p =.29, partial η^2 =.002; between the readmission rate and dual eligibility status, F (1, 607) = .01, p = .94, partial η^2 =.00; or between the receipt of skilled home care and dual eligibility status, F (1, 607) = 3.15, p = .08, partial η^2 =.005. In summary, the readmission rate for MSA subjects without other significant comorbidities was not significantly related to receipt of skilled home care or dual eligibility status. These findings did not support research hypothesis one.

For MSA subjects with a Charlson Comorbidity Index score of 2 or greater, significant relationships were found between the readmission rate

and the receipt of skilled home care, $\underline{F}$ (1, 728) = 11.37, $\underline{p}$ =.00, partial η^2 =.02; and between the readmission rate and dual eligibility status, $\underline{F}$ (1, 728) = 16.32, $\underline{p}$ = .00, partial η^2 =.02. No significant relationship was found between the receipt of skilled home care and dual eligibility status, $\underline{F}$ (2, 728) = .22, $\underline{p}$ = .64, partial η^2 =.00. The receipt of skilled home care and dual eligibility status explained 4.4 percent of the variance. The readmission rate for MSA subjects who had other significant comorbidities in addition to heart failure increased with the receipt of skilled nursing and dual eligibility status.

The relationship between non-MSA and MSA subjects who (a) were readmitted, or (b) were not readmitted during the six months; and the four predictors, Charlson comorbidity category, sex, skilled home care, and dual eligibility were examined further. A logistic regression analysis was calculated for non-MSA and MSA subjects to model predictability of six month readmission for any diagnosis from the four predictors. The odds ratio for these predictors for non-MSA and MSA subjects is reported in Table 18.

Non-MSA subjects who had other comorbidities in addition to heart failure had a 22 percent higher risk of six month readmission for any diagnosis than non-MSA subjects with no other comorbidities. The non-MSA female subjects had a 19 percent decreased risk of six month readmission than males. The non-MSA subjects who were had dual eligibility status were 47 percent more likely to be readmitted at least once during the six months than non-MSA subjects who were not dually eligible.

Table 18

Odds Ratio for Six Month Readmission for Any Diagnosis

Predictor	Odds Ratio	CI (95%)
Charlson category ≥ 2		
Non-MSA	1.22	1.02 – 1.45
MSA	1.64	1.31 – 2.05
Female sex		
Non-MSA	.82	.69 - .98
MSA	ns	ns
Receipt of skilled home care		
Non-MSA	2.11	1.74 – 2.56
MSA	2.09	1.66 – 2.64
Dual Eligibility		
Non-MSA	1.47	1.17 – 1.85
MSA	1.50	1.09 – 2.06

Note. Non-MSA sample N = 2200 and MSA sample N = 1300. CI = confidence interval.

Non-MSA and MSA subjects who received skilled home care were more than twice as likely to be readmitted at least once for any diagnosis during the six months than non-MSA and MSA subjects who did not receive skilled home care. MSA subjects who had other comorbidities in addition to heart failure had a 64 percent higher risk of six month readmission for any

diagnosis. The MSA subjects with dual eligibility status had a 50 percent higher risk of six month readmission for any diagnosis.

Summary. This series of analyses examined research hypothesis one, increased access to healthcare services decreases the frequency of hospital readmission for elderly patients with heart failure over a six month period. Nearly 17 percent of all subjects were readmitted at least once for DRG 127 within six months, and 43.1 percent of all subjects were readmitted for any diagnosis in six months. Diagnosis of additional comorbidities at the index hospitalization was related to increased readmission rates for any diagnosis at 90 days and 180 days time intervals. The analyses of variance and regression analyses in this study included comorbidity as an independent variable. The subject's sex, an individual-level population characteristic, and two access variables, receipt of skilled home care and dual eligibility status, were significantly correlated to the six month readmission for any cause.

After identifying an interaction between comorbidity and the receipt of skilled home care for the non-MSA sample, a two-way analysis of variance was calculated within each comorbidity category to determine the relationship between the six month readmission rate for any diagnosis and the independent variables, skilled home care and dual eligibility status for the non-MSA sample. For non-MSA subjects with a Charlson Comorbidity Index score of 1, an interaction was found between receipt of skilled home care and dual eligibility status, and significant relationships were found between

84

readmission and receipt of skilled home care, and between the readmission rate and dual eligibility status. For subjects receiving skilled home care, having dual eligibility status significantly increased the six month readmission frequency. For subjects not receiving skilled home care, dual eligibility status did not significantly change the six month readmission frequency. Receipt of skilled home care and dual eligibility status explained 2.5 percent of the variance. Table 19 summarizes these findings.

Table 19

Analysis of Variance Results Describing Readmission and Access

Comorbidity	Skilled Home Care	Dual Eligibility	Readmissions
Non-MSA			
CMI = 1	Received home care	Had dual eligibility	Increased
	No home care	+/- Dual eligibility	ns
CMI ≥ 2	Received home care		Increased
		+/- Dual eligibility	ns
MSA			
CMI = 1	+/- Home care		ns
		+/- Dual eligibility	ns
CMI ≥ 2	Received home care		Increased
		Had dual eligibility	Increased

For MSA subjects with a Charlson Comorbidity Index score of 1, no significant relationships were found between six month readmission for any

diagnosis and skilled home care, between the readmission rate and dual eligibility status, or between the receipt of skilled home care and dual eligibility status. For MSA subjects with a Charlson Comorbidity Index score of 2 or greater, significant relationships were found between the readmission rate and the receipt of skilled home care, and between the readmission rate and dual eligibility status. No significant relationship was found between the receipt of skilled home care and dual eligibility status. The receipt of skilled home care and dual eligibility status explained 4.4 percent of the variance. The readmission rate for MSA subjects who had other significant comorbidities in addition to heart failure increased with the receipt of skilled nursing and dual eligibility status.

Summarizing the results of the analyses of variance calculations, significant relationships were consistently identified between increased six month readmission frequency for any diagnosis and the receipt of skilled home care, and between increased six month readmission frequency for any diagnosis and dual eligibility. This finding, increased access increases readmission frequency, does not support research hypothesis one. The exception to this pattern was for MSA subjects without additional comorbidities. In this subsample, subjects who did not receive skilled home care and did not have dual eligibility status had the highest readmissions, but no significant differences were found between readmission frequency

between subjects receiving or not receiving skilled care or between subjects having or not having skilled home care.

Summarizing the results of the regression analyses, skilled home care and dual eligibility status explained only a small portion of the variability in six month readmission rate for any diagnosis; however, the risk of readmission for all subjects was more than twofold when the subjects received skilled home care. Subjects with comorbidities in addition to heart failure experienced greater readmissions; for non-MSA subjects the risk of readmission was increased 22 percent; and for MSA subjects, the risk was increased 64 percent. Being female rather than male in the non-MSA sample reduced the risk for readmission by 18 percent. For non-MSA subjects, having dual eligibility status increased the risk for six month readmission for any diagnosis 47 percent, and for MSA subjects, having dual eligibility status increased the risk of readmission 50 percent. The hypothesis, increased access to healthcare services decreases the frequency of hospital readmission for elderly patients with heart failure over a six month period, was not supported by the findings of these analyses.

Additional exploratory analyses. Further regression analyses examined the relationship of mortality and access. In this sample, mortality was defined as death occurring between months six and twelve during the 12 month data collection period for mortality events. Pearson product-moment correlation coefficients (see Table 20) were calculated between each of the eight access

Table 20

Correlations Among the Access Variables and Six Month Readmission for
Any Diagnosis

Access Variables	Bivariate correlations between each predictor and 12 month mortality		Partial correlations between each predictor and 12 month mortality controlling for other comorbidities	
	Non-MSA	MSA	Non-MSA	MSA
Charlson score	.08**	.12**		
Sex	-.07*	-.05	-.04	.05
Distance to hospital	-.01	-.02	-.03	-.02
County population ≥ 65 per cardiologist	.00	-.05	.00	-.01
County population ≥ 65 per primary physician	-.01	-.01	-.01	-.04
County population ≥ 65 per midlevel practitioner	-.02	-.07*	-.01	-.06*
County population ≥ 65 per ambulance	-.02	-.05	-.01	-.05*
County-based rural primary care hospital	-.03	.00	-.02	-.02
Dual eligibility	.05	.11**	.04	.10**
Skilled home care	.18**	.16**	.18**	.15**

** $p < .005$, *$p < .05$

variables; the Charlson Comorbidity Index scores; and six to twelve month mortality incidence for the non-MSA and MSA subjects. Using the Bonferroni approach to control for Type I error across the 10 correlations, a p-value of less than .005 (05/10 = .005) was required for significance. An increased number of comorbid conditions and receipt of skilled home care were found to be related to an increased six to twelve month mortality for non-MSA subjects. An increased number of comorbid conditions, dual eligibility status, and the receipt of skilled home care were found to be related to increased six to twelve month mortality for MSA subjects. Sicker subjects who received skilled home care in the first six months had greater six to twelve month mortality. When comorbidity was controlled in the correlational analyses, the relationships between six to twelve month mortality and the access variables remained unchanged. As previously described, no significant differences in six to twelve month mortality were detected between the stratified samples.

Logistic regression coefficients were calculated to model the predictability of the six to twelve month mortality from the contributions of comorbidity and the two significantly correlated access predictors for non-MSA and MSA samples. For non-MSA subjects, dual eligibility status did not significantly predict mortality incidence. For non-MSA subjects, receipt of skilled home care and having increased comorbidities did significantly predict mortality incidence. For MSA subjects, comorbidity did not significantly predict mortality incidence. The remaining factor, dual eligibility status, did

significantly predict mortality incidence. More non-MSA subjects with dual eligibility status died within six to twelve months after the index event hospitalization than non-MSA subjects without dual eligibility status (see Table 21). The percentage of non-MSA subjects receiving skilled home care who died within six to twelve months after the index event hospitalization was significantly higher than the non-MSA subjects who did not receive skilled home care, (Pearson χ^2 (1, $\underline{N}$ = 2200) = 14.04, $\underline{p}$ = .00).

Table 21

Mortality Rates Between Six and Twelve Months after Heart Failure Admission

Access Variable	Category	Frequency	Percent
Non-MSA			
Skilled home care	Received care	611	19
	No care	1,589	13
Dual eligibility	Dual eligible	381	16
	Not dual eligible	1,819	14
MSA			
Skilled home care	Received care	457	17
	No care	886	14
Dual eligibility	Dual eligible	199	20
	Not dual eligible	1,144	14

A significantly greater percentage of MSA subjects with dual eligibility died within six to twelve month after the index event hospitalization, as compared to MSA subjects without dual eligibility status, (Pearson χ^2 (1, $\underline{N}$ = 1343) = 4.23, $\underline{p}$ = .04); and a significantly greater percentage of MSA subjects receiving skilled home care died within six to twelve months after the index event hospitalization, as compared to MSA subjects who did not receive skilled home care. Non-MSA subjects who received skilled home care had a 63 percent greater risk of death within six to twelve months of index hospitalization than non-MSA subjects who did not receive skilled home care. MSA subjects who had dual eligibility status had a 53 percent greater risk of death within six to twelve months of the index hospitalization than MSA subjects who did not have dual eligibility status (see Table 22).

Table 22

Odds Ratio for Six to Twelve Month Mortality

Access Variable	Odds Ratio	CI (95%)
Non-MSA		
Dual eligibility	ns	ns
Received skilled home care	1.63	1.27 – 2.10
MSA		
Dual eligibility	1.53	1.04 – 2.26
Received skilled home care	ns	ns

In summary, six to twelve month mortality rates between non-MSA and MSA subjects did not differ. Distance to care and availability of health professionals, by and large, were not found to be significantly related to the six to twelve month mortality rate. Non-MSA subjects who received skilled home care had a 63 percent greater risk of death within six to twelve months after the index hospitalization. MSA subjects who had dual eligibility had a 53 percent greater risk of death within six to twelve months after the index hospitalization.

Re-Examination of Readmission and Access in a Second Sample

As discussed in the review of the literature, no consensus in methodological approach for minimizing internal validity risk related to mortality-related subject loss was identified from the twenty studies using readmission as the outcome measure. To examine the possible differences in the relationship of readmission and access when all subjects who died or lived during the six month data collection for readmission events were included in the sample, another series of regression analyses were performed using the original sample of 4,886 subjects. To control for possible loss of readmission occurrence secondary to premature death, a new variable created to describe the number of days the subject survived during the six month data collection period and was included in all regression analyses.

Description of the sample. The age, sex, and Charlson Comorbidity Index scores of the total sample two were similar to the age, sex, and

92

Charlson Comorbidity Index scores of the previously described sample, to be distinguished in this discussion section as total sample one. Descriptive statistics for the total sample two will be presented with the descriptive statistics for the total sample one provided in brackets. Study subjects ranged in age from 65 to 101 [65 to 101] years, with a mean age of 80.15 years (SD = 7.81) [79.5 years (SD = 7.63)]. Sample two consisted of 2,010 men (41.1%) [1,407 (39.7%)] and 2,876 women (58.9%) [2,136 women (60.3%)]. The county of residence for the sample spanned all 105 Kansas counties. The range of Charlson Comorbidity Index (CMI) scores for both samples ranged from 1 to 9, with a mean score for the total sample two of 1.88 (SD = 1.88) [1.83 (SD = .99)]. Further examination of the Charlson Comorbidity Index scores of sample subjects revealed two categories; those subjects with heart failure as the only morbid condition (CMI = 1), and those subjects with heart failure with additional comorbidities (CMI ≥ 2). When comparing the two samples on the two Charlson categories, the total sample two had slightly greater percentage of subjects with increased comorbidities, as would be expected. 2,235 (45.7%) [1,698 (47.9%)] subjects had a CMI score of 1, and 2,651 (54.3%) [1,845 (52.1%)] subjects had a CMI score of greater than or equal to 2. Twelve month mortality in total sample two was 38.1%.

Regression analyses were performed on the two subsamples stratified by non-MSA/MSA designations using the independent variables significantly correlated to six month readmission for any diagnosis. The results from the

two samples were nearly identical, with one notable difference. The Charlson Comorbidity Index category greater than or equal to 2 no longer was no longer a significant predictor for increased risk of at least one readmission in the non-MSA subjects (see Table 23). The explained variance for this model in the non-MSA subjects was similar at 4.9%.

Table 23

Comparison of Odds Ratio for Six Month Readmission for Any Diagnosis Between Samples

Predictor	Odds Ratio	CI (95%)	Odds Ratio	CI (95%)
	Sample 1	Sample 1	Sample 2	Sample 2
Charlson category > 2				
Non-MSA	1.22	1.02 – 1.45	ns	ns
MSA	1.64	1.31 – 2.05	1.65	1.36 – 2.00
Female sex				
Non-MSA	.82	.69 - .98	.84	.73 - .98
MSA	ns	ns	ns	ns
Receipt of home care				
Non-MSA	2.11	1.74 – 2.56	2.05	1.74 – 2.42
MSA	2.09	1.66 – 2.64	2.32	1.90 – 2.83
Dual eligibility status				
Non-MSA	1.47	1.09 – 2.06	1.43	1.18 – 1.74
MSA	1.50	1.09 – 2.06	1.38	1.07 – 1.79

For the MSA sample, the explained variance was slightly higher at 7.2%, as compared to 4.4% in sample one. Sample two provided the ability to calculate the risk of readmission from the survival time variable. Subjects in the non-MSA sample had an eight percent increased risk of at least one readmission for every month lived during the six month period and MSA subjects had a twelve percent increased risk of at least one readmission for every month lived during the six month period.

In summary, the results of the regression analyses for sample two yielded results similar to sample one. The results found increased access was related to increased readmissions, which did not support research hypothesis one. The one identified difference between samples one and two was the loss of comorbidity as a significant predictor of readmission in the non-MSA subjects for sample two. The lack of significance of comorbidity avoided the need to examine its possible interaction with the relationships between skilled home care or dual eligibility status and readmission in sample two. It is not clear; however, why comorbidity would be less predictive in a sample of subjects with higher six month mortality.

<u>Social Determinants and Population Characteristics</u>

<u>Description of the Sample</u>

The ecological analysis proceeded with the sample of subjects who survived during the six month data collection period. The 3,543 subjects were aggregated into 61 county groupings corresponding to the county of

residence of the subject or groups of Kansas counties including the county of residence of the subject. Subjects residing in frontier counties comprised ten county groupings, subjects residing in rural counties comprised 24 county groupings, subjects residing in densely-settled rural counties comprised 18 county groupings, and subjects residing in metropolitan statistical area counties comprised nine county groupings (see Appendix B). Tables 24 and 25 report the demographic descriptive statistics.

Table 24

Mean and Standard Deviations of Demographic Descriptors

Variables	Frontier	Rural	Dense Rural	MSA
	($\underline{n}$ = 10)	($\underline{n}$ = 24)	($\underline{n}$ = 18)	($\underline{n}$ = 9)
Age	80.42 (1.80)	79.97 (1.08)	79.28 (.92)	79.49 (.93)
Charlson score	1.67 (.20)	1.81 (.14)	1.79 (.12)	1.92 (.16)

Table 25

Frequencies and Percentages of Males and Females

Sex	Frontier	Rural	Dense Rural	MSA
	($\underline{n}$ = 10)	($\underline{n}$ = 24)	($\underline{n}$ = 18)	($\underline{n}$ = 9)
Males	122 (41.4)	360 (40.5)	418 (41.1)	507 (37.8)
Females	173 (58.6)	529 (59.5)	598 (58.9)	836 (62.2)

Description of Readmission, Access, Social Determinants

Tables 26 and 27 provide the descriptive statistics related to readmission and access for the 61 county groupings divided by the population density county categories of frontier, rural, densely-settled rural, and

metropolitan statistical area. In the ecological-level analysis, ten additional variables related to the social determinants of social stability, socioeconomic status, and societal health were added. Noticeable patterns in the social determinant variables were evident with fluctuation corresponding to increasing population density. This social gradient was seen for variables that described negative aspects of societal health, as well as for variables that described positive aspects of societal health (see Figure 3).
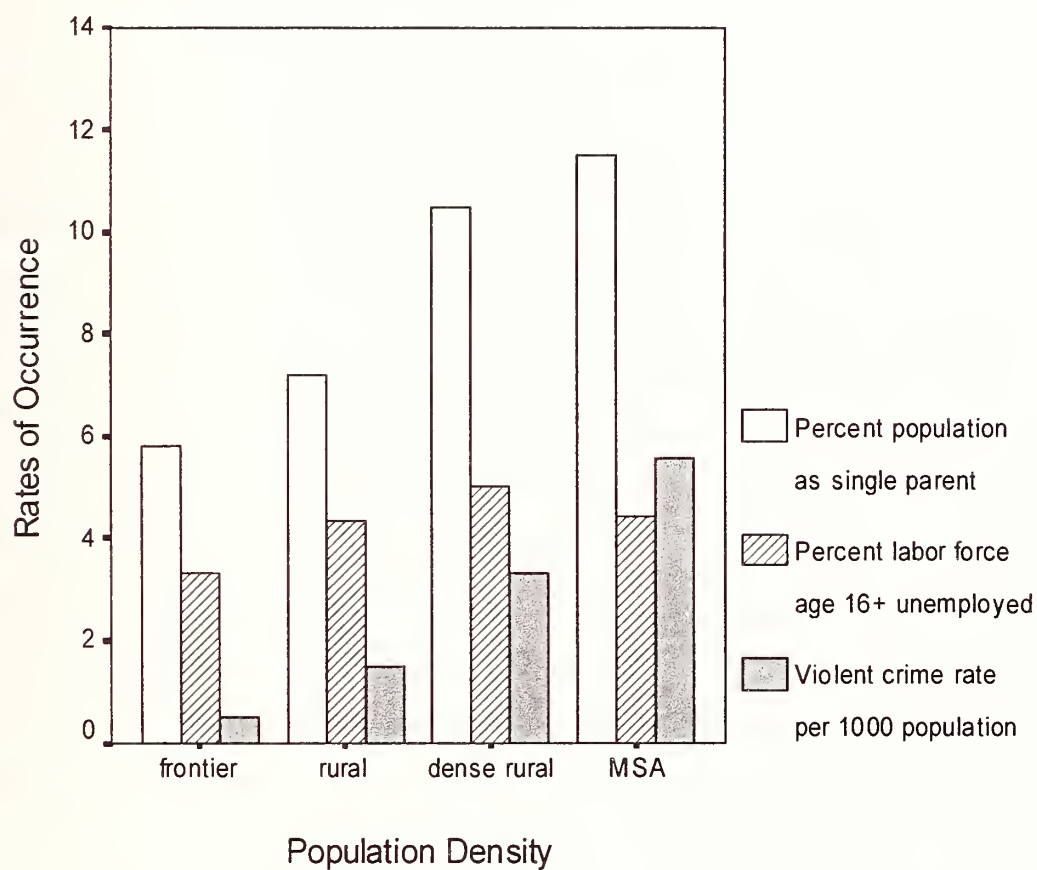
Figure 3. Social determinants describing negative societal health.

Table 26

Mean and Standard Deviations of Readmission and Access Variables

Variables	Frontier (n = 10)	Rural (n = 24)	Dense Rural (n = 18)	MSA (n = 9)
Percent subjects with ≥ 1 readmissions in six months	43.12 (14.32)	44.63 (8.27)	45.26 (7.67)	39.65 (5.98)
Mean Charlson score	1.66 (.20)	1.81 (.14)	1.77 (.11)	1.93 (.17)
Hospital distance in miles	19.49 (7.83)	15.39 (5.79)	11.98 (4.09)	8.97 (4.40)
Population age 65 years and older	2,185 (464)	3,340 (1,132)	5,366 (2,279)	18,162 (16,624)
Percent population ≥ 65	22.41 (4.11)	20.54 (3.42)	14.78 (4.23)	12.02 (2.63)
Population ≥ 65 per cardiologist	--	--	--	3,973 (4,033)
Population ≥ 65 per primary care physician	521 (361)	441 (119)	303 (93)	223 (105)
Population ≥ 65 per midlevel practitioner	574 (360)	852 (776)	426 (206)	322 (229)
Population ≥ 65 per ambulance	277 (99)	482 (250)	759 (226)	1,218 (436)
Percent dually eligible	12.09 (7.12)	18.13 (6.74)	17.91 (4.98)	14.65 (3.75)
Percent receiving skilled home care	19.58 (8.39)	29.74 (10.21)	28.49 (10.53)	33.34 (8.36)

Note. Double dash indicates the mean was not calculated because of the lack of cardiologists in many non-MSA counties.

Table 27

Mean and Standard Deviations of Social Determinants for the 61 County

Groupings

Variables	Frontier (n = 10)	Rural (n = 24)	Dense Rural (n = 18)	MSA (n = 9)
1990 percent single parent households	5.80 (.89)	7.21 (1.19)	10.49 (1.73)	11.49 (3.81)
1990 percent population owning home	76.29 (3.19)	75.66 (2.96)	63.93 (17.62)	66.80 (7.26)
1995 population $\geq$ 16 years unemployed	3.33 (1.08)	4.35 (1.37)	5.04 (1.00)	4.33 (1.10)
1990 median household income	21,244 (2,336)	22,277 (2,233)	23,473 (2,467)	30,241 (5,443)
Percent population below 200% poverty	41.80 (3.46)	40.18 (3.79)	37.86 (5.07)	27.49 (7.86)
Percent population with college degree	13.46 (1.73)	12.72 (2.27)	16.41 (5.52)	23.49 (7.86)
Percent population graduating high school	77.34 (2.54)	77.00 (2.79)	77.98 (4.90)	82.63 (6.47)
Violent crime rate per 1,000 population	.53 (.34)	1.50 (.60)	3.32 (1.91)	5.57 (5.31)
Percent of motor vehicle accidents resulting in injury	25.39 (2.80)	24.81 (3.27)	27.89 (4.12)	30.81 (4.74)
Age-adjusted death rate per 100,000 population	447 (31)	455 (34)	480 (49)	474 (76)

A negative social gradient was described by increasing rates of single-parent households, violent crime, and unemployment as the population density increased. For unemployment, the highest rate of unemployment occurred in the densely-settled rural county groupings. Conversely, a positive social gradient was described by increasing rates of high school and college education, median household income, and the decreasing poverty rate as the population density increased (see Figure 4). Interestingly, the gradient between the densely-settled rural counties and the metropolitan statistical
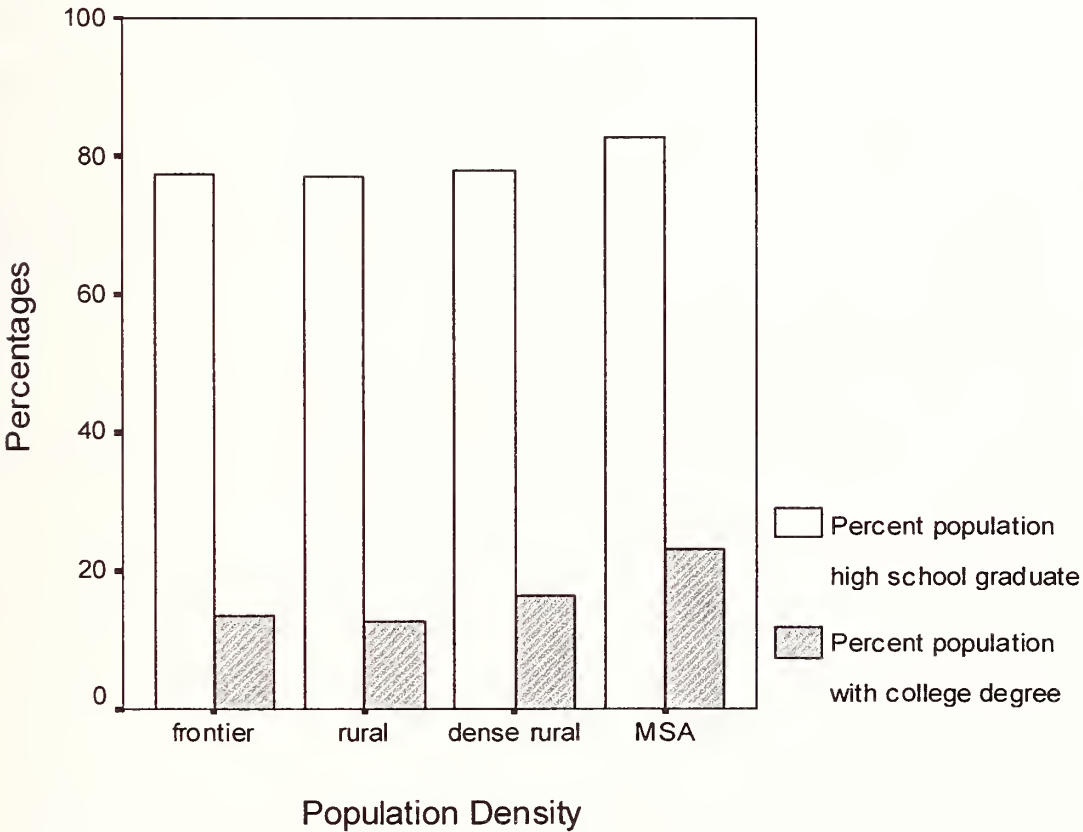
Figure 4. Social determinants describing positive societal health.

area counties reversed directions with some social determinant variables, such as unemployment rates.

Effects of Social Determinants

Research hypothesis two, the inclusion of the social determinants of social stability, socioeconomic status, or overall societal health increases the explained variability in hospital readmission for elderly patients with heart failure over a six month period, was supported. Pearson product-moment correlation coefficients were calculated between each of the nine access variables; the mean Charlson Comorbidity Index scores; the ten social determinant variables; and the dependent variable, the percent of subjects having one or more readmissions for any diagnosis within six months (Table 28). Using the Bonferroni approach to control for Type I error across the 21 correlations, a p-value of less than .002 (05/21 = .002) was required for significance.

A linear regression was calculated to model predictability of being readmitted from the twelve weakly correlated ($r \geq .09$) predictors. Distance to index hospitalization ($R^2 = .02$), percent of subjects with dual eligibility status ($R^2 = .13$), and the unemployment rate ($R^2 = .034$) were significantly related to one or more readmissions for any diagnosis within six months, F (3, 57) = 4.29, $p = .008$. This combination of one access and two social determinant variables explained 18.4 percent of the variability of at least one readmission for any diagnosis within six months (see Figure 5).

Table 28

Bivariate Correlations between Access Variables and Six Months

Readmission for Any Diagnosis

Predictor	Bivariate correlations between each predictor and percent of subjects with one or more readmissions for any cause in six months
Mean Charlson score	-.11
Hospital distance in miles	.09
Population age 65 years and older	-.06
Percent population $\geq$ 65 years	.10
Population $\geq$ 65 years per cardiologist	.16
Population $\geq$ 65 years per primary physician	-.17
Population $\geq$ 65 per midlevel practitioner	.05
Population $\geq$ 65 per ambulance	-.15
Percent dually eligible	.37*
Percent receiving skilled home care	-.18
1990 percent single parent households	-.13
1990 percent population owning home	.13
1995 population $\geq$ 16 years unemployed	-.10
1990 median household income	-.03
Percent population below 200% poverty	.01
Percent population with college degree	-.14
Percent population graduating high school	-.11
Violent crime rate per 1,000 population	-.08
Percent injury-related motor vehicle accident	-.07
Age-adjusted death rate per 100,000 population	.01

* p = .003
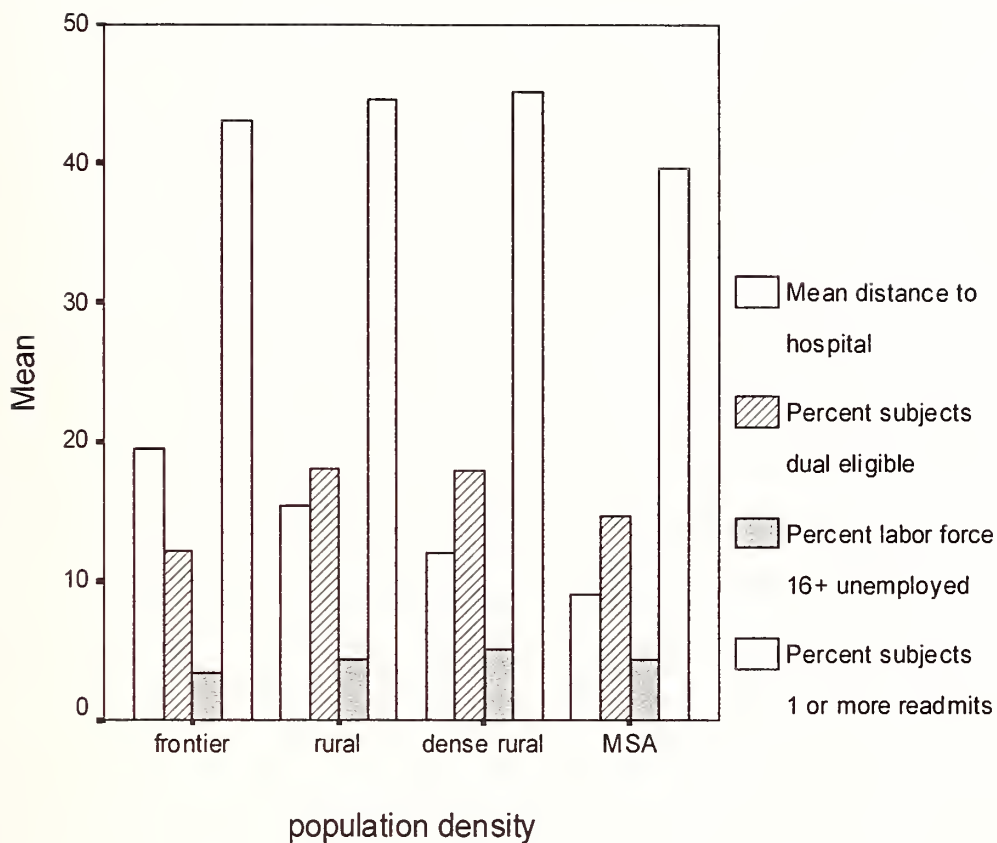
Figure 5. Access and social determinant variables that predict readmission.

A logistic regression calculation determined the odds ratio of having one or more readmissions for these three variables (see Table 29). Transformation of these three continuous variables into categorical variables was guided by descriptive statistics about non-MSA versus MSA county groupings. Residents in county groupings who traveled greater than 15 miles to care had more than a threefold greater risk of at least one readmission for any diagnosis during the six month study period. Residents of county groupings with a 14 percent or higher dual eligibility rate had a nearly

sevenfold risk of at least one readmission. Residents of county groupings with unemployment rates of 3.3 percent and higher had an 80 percent decreased risk of at least one readmission. The significance and 95% confidence intervals for the three B weights are reported in Table 30.

Table 29

Odds Ratio for One or More Readmissions for Any Cause Within Six months

Predictor	Reference	Odds Ratio
Distance to index hospitalization	> 15 miles	3.36
Percent dual eligibility	> 14%	6.68
Percent unemployment	> 3.3%	.20

Table 30

Results of Significance Testing of the Three Predictors of Readmission

Predictor	B weight	P value	CI (95%)
Distance to hospital	1.21	.05	.99 – 11.43
Percent dual eligibility	1.89	.03	1.5 – 29.31
Percent unemployment	-1.61	.01	.05 – .81

The predicted values obtained from logistic regression calculations identified counties at high risk and low risk for residents to have one or more readmissions for any diagnosis within six months. Counties with predicted values above .70 and below .30 were labeled high and low risk, respectively. The high risk counties were frontier and rural counties, with the exception of

the densely-rural Allen county, and were predominantly located in western

Kansas (see Table 31). The low risk counties were found in rural, densely-

settled rural, and urban (MSA) counties, and were predominantly located in

eastern Kansas (see Table 32). The predicted values for the high risk group

accurately predicted 71.4 percent of the readmission patterns of the counties.

The predicted values for the low risk group accurately predicted 72.7 percent

of the counties' readmission patterns for the counties.

Table 31

<u>County Groupings at High Risk for Readmission</u>

Cluster	Population Density	Counties	Predicted Value
3	Frontier	Clark, Edwards, Kiowa, Meade	.75
6	Frontier	Hodgeman, Lane, Ness	.85
7	Frontier	Jewell, Smith	.72
9	Frontier	Greeley, Kearney, Morton, Stanton, Wichita	.90
18	Rural	Grant, Hamilton, Stevens	.77
19	Rural	Chautauqua, Greenwood	.75
28	Rural	Norton, Phillips, Rooks	.92
29	Rural	Osage	.82
30	Rural	Pratt	.85
31	Rural	Mitchell, Republic, Washington	.89
35	Dense Rural	Allen	.71

Table 32

County Groupings at Low Risk for Readmission

Cluster	Population Density	Counties	Predicted Value
16	Rural	Dickinson	.24
33	Rural	Sherman, Thomas	.22
38	Dense Rural	Cowley	.29
46	Dense Rural	Atchison	.15
49	Dense Rural	Montgomery	.24
54	MSA	Douglas	.26
59	MSA	Sedgwick	.28
61	MSA	Wyandotte	.17

In summary, the 3,543 subjects were aggregated into 61 county groupings representing Kansas counties or groupings of Kansas counties. Subjects residing in frontier, rural, densely-settled rural, and metropolitan statistical areas were clustered within each separate population density category. Ten variables describing social determinants were added to the analysis to further explain the variability in six months readmission rates for any diagnosis. Linear and logistic regression analyses identified one factor which approached significance and two significant factors that modeled the predictability of having one or more readmissions for any cause within six

months. Residents in county groupings who traveled greater than 15 miles to care had more than a threefold greater risk of at least one readmission for any diagnosis during the six months. Residents of county groupings with a 14 percent or higher dual eligibility rate had a nearly sevenfold risk of at least one readmission. Residents of county groupings with unemployment rates of 3.3 percent and higher had an 80 percent decreased risk of at least one readmission. The distance to index hospitalization, dual eligibility rate, and unemployment rate explained 18.4 percent of the variance. The predicted values identified county groupings at high and low risk of readmission for any cause. The high risk counties were primarily frontier and rural counties in western Kansas. The low risk counties were primarily densely-settled rural and urban counties in eastern Kansas.

Summary

The purposes of this retrospective cohort study were to examine the relationships between access and heart failure outcomes for elderly Kansans. The population included all Medicare enrollees age 65 years and older in the state of Kansas discharged with a hospital discharge diagnosis coded DRG 127 during 1995. Subjects hospitalized between January 1 and December 31, 1995 were followed for a six month period, with data collection concluding June 30, 1996. The mortality data related to these subjects was tracked for one year from the time of initial index event hospitalization.

The criteria for the selection of subjects included: (a) having a hospital discharge diagnosis of DRG 127, (b) were enrolled in the Medicare A and B programs, and (c) were born by 1929. All individuals, regardless of gender or ethnicity, meeting these criteria were included in the study. Individuals were excluded from the study if they died during the six month data collection period for readmissions.

The sample for this study consisted of 3,543 subjects who met the inclusion criteria. Two levels of analysis were performed to examine the relationship of access to care and readmission for any diagnosis within six months of the initial hospitalization. Research hypothesis one examined the relationship between readmission and access at an individual-level of analysis with stratified samples based upon the population density of the county of residence categorized as a metropolitan statistical area or non-metropolitan statistical area (MSA/non-MSA). Research hypothesis two expanded the examination of readmission and access by including county level social determinants of health and was examined at an ecological-level of analysis using county groupings as the level of analysis.

The distribution of age and sex of the entire sample was similar between the non-MSA and MSA samples. The mean age of the sample was 79 years, with 60% of the subjects being female and 40% of the subjects being male. Sample subjects resided in all 105 counties of the state, with eight percent of the subjects residing in frontier counties, 25 percent residing

in rural counties, 29 percent residing in densely-settled rural counties, and 38 percent residing in MSA counties. The mean Charlson Comorbidity Index score for the sample was 1.83 ($\underline{SD}$ = .99), reflecting the fact that more than half of the subjects had other comorbidities in addition to heart failure. MSA subjects experienced significantly more comorbid conditions at the time of index hospitalization than non-MSA subjects.

Sixteen percent of the subjects were readmitted at least once for DRG 127 in six months, and 43.1 percent were readmitted for any diagnosis within six months. For non-MSA subjects, the mean number of readmissions within six months for DRG 127 was .24 ($\underline{SD}$ = .59) and the mean number of readmissions for any diagnosis was .77 ($\underline{SD}$ = 1.12). For MSA subjects, the mean number of readmissions within six months for DRG 127 was .23 ($\underline{SD}$ = .60) and the mean number of readmissions for any diagnosis was .67 ($\underline{SD}$ = 1.03). Diagnosis of additional comorbidities at the index hospitalization was significantly related to increased readmission rates for any cause at 90 days and 180 days time intervals. To control for the confounding influence of comorbidity, the analyses of variance and regression analyses included comorbidity as an independent variable.

Readmission and Access

Research hypothesis one, increased access to healthcare services decreases the frequency of hospital readmission for elderly patients with heart failure over a six month period, was not supported. While non-MSA

subjects had longer distances to the index hospitalization site, increased population per specialty or primary care, increased population per ambulance, and decreased percent of population with dual eligibility status or receiving skilled home care, analyses of variance found no positive, significant relationships between the six month readmission rate and any of these variables. In contrast to the hypothesized relationship, readmission rates increased among those having dual eligibility status and receiving skilled home care.

Non-MSA sample. After identifying that comorbidity confounded the relationship between readmission and skilled home care for the non-MSA sample, a two-way analysis of variance was calculated within each comorbidity category to determine the relationship between the six month readmission rate for any diagnosis and the independent variables, skilled home care and dual eligibility status. For non-MSA subjects with a Charlson Comorbidity Index score of 1, receipt of skilled home care and having dual eligibility status significantly increased the six month readmission frequency. For subjects not receiving skilled home care, dual eligibility status did not significantly change the six month readmission frequency. Receipt of skilled home care and dual eligibility status explained 2.5 percent of the variance. Non-MSA subjects who received skilled home care and had dual eligibility status had the highest six month readmission rate for any diagnosis. The risk of six month readmission for any diagnosis was more than twofold for non-

MSA subjects when they received skilled home care. Non-MSA subjects who had dual eligibility status were 47 percent more likely to be readmitted at least once during the six months. For non-MSA subjects, two additional variables contributed to the prediction of readmission risk. Female non-MSA subjects had an 18 percent decreased risk of readmission as compared to males. Non-MSA subjects who had other comorbidities in addition to heart failure had a 22 percent increased risk of readmission.

MSA sample. The readmission rate for MSA subjects with heart failure as their only comorbidity was not significantly related to the receipt of skilled home care or dual eligibility status. MSA subjects with additional comorbidities that either received skilled home care or had dual eligibility status had higher readmissions than those subjects who did not receive skilled home care or have dual eligibility status. These two predictors explained 4.4 percent of the variance for MSA subjects. The risk of six month readmission for any diagnosis was more than twofold for MSA subjects when they received skilled home care. MSA subjects who had dual eligibility status were 50 percent more likely to be readmitted at least once during the six months.

Other analyses. Mortality rates for non-MSA and MSA samples were examined for the period of six to twelve months after the index event hospitalization. Mortality rates between non-MSA and MSA subjects were not significantly different. Distance to care and availability of healthcare services

111

were not significantly related to six to twelve month mortality incidence. Non-MSA subjects who received skilled home care had a 62 percent greater risk of death within six to twelve months after the index hospitalization. MSA subjects who had dual eligibility had a 53 percent greater risk of death within six to twelve months after the index hospitalization. Again, increased access to select services in ill subjects was related to increased the risk of dying within the period of six to twelve months after index hospitalization.

A final examination of the relationship between access and readmission at the individual level was performed using the entire original sample. All subjects previously censored due to death during the six month data collection were included in the reconfigured sample, identified as sample two, and linear and logistic regression analyses re-examined the relationships between readmission and access. The results of the regression analyses for sample two yielded results similar to those found with sample one. The results did not support research hypothesis one; rather the results found that increased access increased readmissions. A difference identified between the two samples was the loss of comorbidity as a significant predictor of readmission in the non-MSA subjects for sample two.

Effects of Social Determinants

Research hypothesis two, the inclusion of the social determinants of social stability, socioeconomic status, or overall societal health increased the explained variability in hospital readmission for elderly patients with heart

112

failure over a six month period, was supported. To answer research hypothesis two, the 3,543 subjects were aggregated into 61 county groupings corresponding to a single Kansas county or groups of Kansas counties. All county groupings were assigned based on the population density categories of frontier, rural, densely-settled rural, or metropolitan statistical area counties. Ten additional variables describing the social determinants of social stability, socioeconomic status, and societal health were included. Linear and logistic regression analyses identified three factors that modeled predictability of having one or more readmissions for any diagnosis within six months. The distance to index hospitalization, dual eligibility rate, and unemployment rate explained 18.4 percent of the variance. Residents in county groupings who traveled greater than 15 miles to care had more than a threefold greater risk of at least one readmission for any diagnosis during the six months. Residents of county groupings with a 14 percent or higher dual eligibility rate had a nearly sevenfold risk of at least one readmission. Residents of county groupings with unemployment rates of 3.3 percent and higher had an 80 percent decreased risk of at least one readmission. The variables of dual eligibility and unemployment rate were statistically significant at alpha = .05. The third factor, the mean distance from residence to the site of index hospitalization, approached significance. Small sample size ($\underline{n}$ = 61) provided inadequate power to achieve statistical significance of this variable at alpha = .05. Predicted values calculated from the logistic regression identified county

groupings at high and low risk of readmission for any cause. The high risk

counties were primarily frontier and rural counties in western Kansas. The low

risk counties were primarily densely-settled rural and urban counties in

eastern Kansas.

CHAPTER V

Discussion

Chapter V provides an overview of the significant findings and a discussion of the relevance of each finding. Conclusions related to the findings of this study on access to care and readmission among Kansas elders are summarized and the limitations of the study are acknowledged. The chapter concludes with a discussion on the implications for nursing and recommendations for future study on negative health outcomes for persons with heart failure.

The research hypotheses for this study were framed utilizing the conceptual model developed by Aday and Andersen (1974) which delineated key relationships between variables which could impact access to healthcare services. The Framework for the Study of Access described the interaction between potential and realized access. Using Donabedian's (1980) quality framework, potential and realized access was described by structural and process indicators. Structural indicators of potential access included the availability of healthcare providers measured by the distance to, or by the distribution of, providers. Process indicators of potential access described the predisposing and enabling characteristics of populations-at-risk, including the demographic, disease specific, and social determinant characteristics measured at the individual and ecological levels. Realized access measured actual utilization of healthcare services by individuals and their reactions to

those services. The objective indicators of realized access were the actual utilization of services. The subjective indicators of realized access measured the satisfaction of the user with the quantity or quality of care and was not typically linked to a specific episode of care. No subjective indicators of realized access were included in this study.

The framework depicted an uni-directional relationship between health policy and potential access, which in turn, affected realized access. Structural and process indicators of potential access reciprocally affected each other, The premise of this framework was that potential access must exist before realized access can occur. The current study examined the relationship between the characteristics of Kansas health delivery systems and the population-at-risk for experiencing hospital readmission for DRG 127 or for any diagnosis as an outcome of heart failure. The population-at-risk in this study were Kansas elders with heart failure during 1995.

<div align="center">Findings</div>

Individual Level Population Characteristics

The first research hypothesis examined the relationship between availability of healthcare services; individual-level predisposing and enabling characteristics; and the dependent variables of readmission for DRG 127 and readmission for any diagnosis. Research hypothesis one, increased access to healthcare services decreases the frequency of hospital readmission for elderly patients with heart failure over a six month period, was not supported.

Descriptively, subjects living in non-MSA counties were more frequently readmitted for both DRG 127 and for any diagnosis at all time intervals than subjects living in MSA counties. Subjects living in non-MSA counties had diminished potential access, including longer distances to the site of the index hospitalization, increased population per specialty or primary care, and increased population per ambulance. None of these factors, however, were significantly related to the six month readmission for any cause in the individual-level analysis.

The significant positive relationship between the receipt of skilled home care and increased readmission rates, does not support hypothesis one. These findings contradict the results of the study reported by Lazarre and Ax (1997) and the general perception that receipt of skilled home care by vulnerable, chronically ill populations reduces the need for acute hospitalization. Reasons for this relationship may include the fact that patients at greater risk of readmission to the hospital are in greater need for skilled home care services.

The level of comorbidity influenced readmission rates for subjects receiving skilled home care and having dual eligibility status in non-MSA counties. Non-MSA subjects with no other significant comorbidities other than heart failure that received skilled home care and had dual eligibility status had significantly more readmissions for heart failure than those subjects who did not have dual eligibility status. The subjects with greater disease burden were

readmitted more frequently when they received skilled home care regardless of their dual eligibility status. It is speculated that insurance status is less important in determining readmission frequency when persons have more severe disease. When the illness burden increased, readmission rates increased, regardless of dual eligibility status. Subjects with dual eligibility status and increased comorbidity had significantly greater readmissions.

Research hypothesis one was again not supported when a second sample which included all subjects who survived or died during the six month data collection period for readmissions was analyzed. The results of the linear and logistic regression analyses were similar to the results obtained from sample one, with the only notable difference being the loss of significance of increased comorbidity as a predictor of increased readmissions in the non-MSA sample. It appears from these findings that the subjects who died in the first six months of data collection were quite similar to those subjects who did not die during the first six months, with the exception of comorbidity. Not surprisingly, subjects with more comorbidities died more frequently. Interestingly, when subjects with more comorbidities were included in the sample, the effect of comorbidity was negated.

In this cohort of subjects with heart failure, the threat to internal validity due to mortality loss of subjects appears to have been limited. The potential reasons for this finding may be that all subjects have a high risk of mortality and therefore subject loss due to mortality does not significantly change the

sample. The loss of homogenous subjects does not alter the overall sample descriptors. Inclusion of all subjects in the analysis provided an opportunity to describe the relationship between the length of survival and risk of readmission, and allowed an accurate description of the twelve month mortality frequency. For sample two, the readmission risk increased between eight and twelve percent for every month the subject survived during the six month data collection period. The twelve month mortality rate for sample two was 38.1%. Wolinsky et al. (1997) examined mortality rates of 7,286 adults aged 70 years and older who were hospitalized for heart failure found the twelve month mortality rate to be 34.7%. In comparison to this one study, Kansas elders with heart failure had greater mortality.

The factors describing availability of healthcare services were not significantly related to readmission rates. It must be noted that these analyses used county-based availability rates to operationalize these variables, and this strategy may not have captured the actual availability at an individual level. In summary, the healthcare delivery system characteristics and the population-at-risk characteristics explained only a small amount of the variability in readmission rates. The use of these variables was insufficient to understand the contributors to negative health outcomes for elderly Kansans with heart failure.

<u>Effects of Social Determinants</u>

Research hypothesis two, the inclusion of the social determinants of social stability, socioeconomic status, or overall societal health increases the explained variability in hospital readmission for elderly patients with heart failure over a six month period, was supported. As described by Marmot, social determinants are crucial to understanding cardiovascular disease (Marmot, Ryff et al., 1997). The inclusion of social determinant variables did increase the explained variability of the six month readmission for any diagnosis. The variables describing social stability (unemployment rate) and socioeconomic status (dual eligibility) were combined with the distance to the site of the index hospitalization (potential access) to explain 18.4 percent of the variance, as compared to the explained variance of 2.5 to 4.4 percent using traditional access variables. This proportional increase in explanatory power is small, but deserves attention given the complexity of the relationship between potential and realized access. The majority of the explained variance was contributed by the variable describing dual eligibility. Dual eligibility at the ecological-level described the percent of the subjects within each county or county grouping with dual eligibility status.

Aggregation of the data provided additional opportunities to examine the relationships between access and readmission. The aggregation of data to the population level resulted in significance for some variables to be more clearly represented, such as distance to care, and loss of significance to

others such as skilled home care. This provides support for the examination of access at both the individual and ecological levels to achieve the most thorough understanding of the relationship between potential and realized access. Ecological analyses included in this study suggest that population characteristics of community well-being, such as unemployment, play a role in the social gradient differences in heart failure readmissions. The findings of this study support existing literature on the influence of social determinants to explain the variability in readmission rates for persons with heart failure.

Linear and logistic regression analyses identified three significant factors that modeled the predictability of having one or more readmissions for any diagnosis within six months. The distance to index hospitalization, dual eligibility rate, and unemployment rate explained 18.4 percent of the variance. Residents in county groupings who traveled greater than 15 miles to care had more than a threefold greater risk of at least one readmission for any diagnosis during the six months. Residents of county groupings with a 14 percent or higher dual eligibility rate had a nearly sevenfold risk of at least one readmission. Residents of county groupings with unemployment rates of 3.3 percent and higher had an 80 percent decreased risk of at least one readmission within six months

The study finding that increased distance to care increased readmission rates contradicts previous study findings that concluded that increased distance to care was related to a decreased utilization of services

(Holloway et al., 1990; Luft et al., 1990; Piette & Moos, 1996). In those studies, however, utilization of services was focused on the use of outpatient and physician services, rather than readmission for acute services. The results of this study provide important information about access to hospital care. Residents of frontier and rural counties traveled, on average, more than ten miles further to hospital care than subjects in MSA counties. This finding may suggest that a continued pursuit of strategies to improve hospital access for rural Kansans is warranted. However a contrasting view could challenge the importance of distance to care as a characteristic of access. The time that it takes to obtain care may be more useful than mileage. No studies were reviewed that examined this relationship.

Dual eligibility status was the only individual-level variable that significantly contributed to the prediction of readmission rates at the ecological level. Findings of this study suggest that dual eligibility status at the ecological level may describe a negative, rather than a positive, socioeconomic characteristic of the population-at-risk. Many forms of dual eligibility exist, but all have a poverty-related component. Residents of county groupings with higher than 14% of subjects having dual eligibility status were at high risk for at least one readmission within six months. No other studies were identified in the literature that examined dual eligibility status and predicted hospital use.

The study finding that residents living in counties with higher unemployment rates have a 80 percent decreased risk of readmission was somewhat surprising. Two possible explanations for the results are suggested. The first explanation is that the unemployment rate reflects the total county population and is not a useful indicator of social stability for elders who are retired and are not part of the cohort measured for employment. The second explanation considers unemployment rate as an indicator of social stability. The positive relationship between unemployment rates and readmission rates may reflect the fact that county groupings with less social stability may utilize hospital services less frequently. It is plausible that subjects without employment have no income or insurance for hospital care, and therefore are not admitted to the hospital.

The correlational analyses suggested that other social determinant variables were related to the readmission rate, but the small sample size ($\underline{N}$ = 61) lacked sufficient power to detect small or medium effects. The use of social determinant variables, however, helped to describe why readmission rates are higher for rural counties, despite lower comorbidities. Social Finally, the counties with residents predicted to be at high risk for readmissions were frontier and rural counties located in western Kansas. This study finding was well supported by the literature.

Significant differences were found between the six to twelve month mortality rates and comorbidity as measured by the Charlson Comorbidity Index Score. These findings support the use of the Charlson Comorbidity to differentiate between persons with heart failure according to disease burden.

Findings of this study indicated that in 1995, the Kansas 30-day readmission rate for any diagnosis 16.9% compared favorable with the national rate of 17.2%. However, the 38.1% annual mortality rate was higher than the 34.7% mortality rate reported by Wolinsky et al., (1997). These findings provide contradictory evidence for two negative health outcomes for Kansas elderly with heart failure.

In summary, the findings of this study indicated that increased receipt of skilled home care and having dual eligibility status increased readmission frequency. Increased comorbidities were most commonly associated with increased readmission rates. The increased access to skilled home care and the added benefit package available to those with dual eligibility status did not decrease hospital readmissions as hypothesized. The cause for this direction of effect needs further investigation as is and contradicts previous study findings. At the ecological level, social determinants did provide additional explanatory power of the relationship between readmission and access to care, as hypothesized in the second research hypothesis. The major explanatory variable continued to be related to having dual eligibility status.

Those subjects with dual eligibility status had increased readmission frequency for any diagnosis within six months.

Conclusions

Several conclusions can be drawn from the data findings of this study. They are as follows:

1. No traditional access factors describing the health delivery system, measured at the individual level, significantly predicted readmission frequency for any diagnosis for elderly patients with heart failure over a six month period.

2. The use of ecological-level analyses with the inclusion of social determinant variables increased the understanding of the variability in readmission rates for elderly Kansans with heart failure.

3. Kansas residents with predicted highest risk for at least one readmission for any diagnosis within six months lived in counties located in the western portion of the state. Those residents with predicted low risk for at least one readmission for any diagnosis in six months lived in counties located in the eastern portion of the state.

4. Kansas elders with heart failure were below the national average in readmissions for any diagnosis at 30 days. The Kansas annual mortality rate of 38.1% was higher than that reported in other studies of 34.7% (Wolinsky et al., 1997).

5. Six month readmission rates for any diagnosis were higher for residents of non-metropolitan statistical areas of the state. Residents of non-MSA counties had an increased distance to hospital care, increased comorbidity, increased dual eligibility status, received more skilled home care, and lived in counties with decreased unemployment rates.

6. The variables which were significantly related to increased readmission rates for any diagnosis at six months included receipt of skilled home care, dual eligibility status, having other comorbidities in addition to heart failure, increased distance to hospital care, lower unemployment rates, and for MSA subjects, being a male.

Limitations

The ability to fully describe a complex phenomenon such as access is a challenging task. Further examination of the relationships between access and heart failure outcomes will continue to clarify which approaches to data collection, transformation, and analysis are most appropriate. Much knowledge was gained during the completion of this preliminary study. At present, the following limitations for this study were identified:

1. The study was largely limited by the lack of precision in administrative claims data. The Part B data describing skilled home care lacked information about individual visits. In 1995, the claims data for skilled home care did not reflect a single visit, but rather reflected the monthly billing cycles for the services. The data did not reflect the intensity of

service or the exact timing of the services. Another limitation was the lack of information about additional insurance to supplement Medicare coverage. Given the significance of dual eligibility in this study, a more thorough examination of the all insurance options available to Medicare beneficiaries is indicated, including the subcategories of dual eligibility status. Administrative data bases are subject to coding errors and may not accurately reflect the true diagnostic categories for the subjects. The lack of individual-level data to describe the health delivery characteristics introduced validity concerns. While use of provider rates is common in ecological-level analyses, use of rates to describe access in a highly mobile society may be an inaccurate method of description. Similarly, additional data describing the health behaviors and severity-of-illness of the population-at-risk would provide fuller description of the variability in heart failure outcomes.

2. A major limitation of the study was the inclusion of all subjects, regardless of residence, after discharge from the index event hospitalization. Those subjects living in extended care facilities would be less likely to receive skilled home services and be more likely to have dual eligibility status, thus altering the relationships between readmission and receipt of skilled home care and/or having dual eligibility status.

<u>Implications for Nursing and Outcomes Research</u>

This study combined traditional access and social determinant factors to successfully expand the predictive model to better explain the variability in readmission rates for heart failure. Heart failure continues to increase in incidence and prevalence, so a better understanding of measures related to community well-being and more specific measures of access at the individual level, such as the influence of dual eligibility status, provided a richer understanding of the contributors to negative health outcomes for persons with heart failure.

The implications for health outcomes researchers are twofold. First, health researchers must seek the causes to explain the variability in negative health outcomes using a broader, community-based perspective. The implication for nursing focuses on use of skilled home care. A continued use of skilled home care is predicted as acute care health care systems further reduce of inpatient length of stay. More information is needed to understand the relationship between the increased receipt of skilled home care and increased readmission rates. A plausible explanation for the relationship between increased receipt of skilled home care and increased readmission rate is that very ill individuals who require increased skilled home care may also need increased hospital care. The quality and content of skilled home care services must be evaluated to determine effective strategies in reducing hospital readmission rates for persons with heart failure. Other studies have

found that intensive discharge instruction and skilled home care do reduce readmission rates. Another plausible reason for the relationship between receipt of skilled home care and increased readmissions is the inclusion of subjects living in extended care facilities. Subjects living in these facilities most likely do not receive skilled home care and the assumption of normal distribution of readmission risk is violated.

The findings of this study have implications for health policy. The finding that increased use of skilled home care increases readmissions questions the current Medicare policy incentives to reduce the length of stay for individuals with heart failure. When individuals with more disease burden are discharged from the hospital earlier and then require skilled home care, the findings of this study suggest that these individuals are readmitted more frequently. Another question posed by the findings of this study is whether the combined package of Medicare and Medicaid health insurance is effective in improving the health of individuals. The dual eligibility insurance benefit package should be re-examined to determine the effectiveness of this program to improve the health of elderly individuals.

Nursing researchers have historically examined populations at risk using a holistic framework that examines individuals within the context of their environment. This study provides support for the continuing inclusion of social determinants as important indicators of overall community well-being and individual health.

Recommendations for Future Research

The findings of this study are descriptive and correlational in nature. Based on the results of this study, recommendations for further study include:

1. Replication of portions of this study using different time periods and a longer data collection period to obtain larger samples for the aggregated analysis.

2. Examination of readmission rates using record-level data on actual utilization of healthcare services. One example would be to obtain physician codes from the claims database to determine whether the subject received primary or specialty care or both types of care.

3. A strong recommendation for future research is to more closely examine the population of subjects who have dual eligibility status. Readmission of subjects with dual eligibility may be related to factors not examined in this research study, including where the subjects resided and the category of dual eligibility possessed by the subjects. It is acknowledged that readmission is sometimes a function of insurance status and utilization constraints experienced by extended care and acute care facilities. This relationship requires analysis in light of the results of this study.

4. Further analysis of this data would be improved with variables describing location of residence after discharge. Residence in a long-term care facility may be confounding the relationships between skilled home care, dual eligibility status, and readmission.

5. While several social determinant variables were included in this study, further work is needed to determine the most appropriate way to operationalize the concept of community well-being in relation to the population of interest. Qualitative research is needed to identify key variables that describe community well-being for elders with heart failure.

6. Continued evaluation is needed to determine the best approach for clustering readmission events in the most meaningful and valid way for data analysis and interpretation.

7. While this study closely examined total six month readmissions for any diagnosis, further examination of other measurements of readmission incidence is warranted, particularly for total six month readmissions for DRG 127.

8. While comorbidity at time of index hospitalization was controlled with the Charlson Comorbidity Index, future research should consider additional measures to control for new comorbidity occurrence during the data collection period, as well as adding a control measure to reflect severity of illness.

References

Aday, L., & Andersen, R. (1984). The national profile of access to medical care: Where do we stand? <u>American Journal of Public Health, 74,</u> 1331-1339.

Aday, L., Andersen, R., & Fleming, G.V. (1980). <u>Healthcare in the U.S. Equitable for Whom?</u> Beverly Hills: Sage.

Alexander, M., Grumbach, K., Selby, J., Brown, A.F., & Washington, E. (1995). Hospitalization for congestive heart failure: Explaining racial differences. <u>Journal of American Medical Association, 274,</u> 1037-1042.

Alexy, B., Elnitsky, C., & Nichols, B. (1996). Hospital readmissions for rural elderly: 1992-1993. <u>Journal of Nursing Administration, 26</u>(11), 10-16.

American Heart Association. (1998). <u>1997 Heart and Stroke Facts.</u> Dallas: Author.

Andersen (1968). <u>A behavioral model of families - use of healthcare services.</u> Chicago: Center for Health Administration Studies.

Aronow, W. (1997). Treatment of congestive heart failure in older persons. <u>Journal of American Geriatrics Society, 45,</u> 1252-1258.

Ashton, C.M., Kuykendall, DH, Johnson, M.L., Wray, N.P., & Wu, L. (1995). The association between the quality of inpatient care and early readmision. <u>Annals of Internal Medicine, 122,</u> 415-421.

Baker, D., Konstam, M., Bottorff, M., & Pitt, B. (1994). Management of heart failure: Pharmacologic treatment. Journal of American Medical Association, 272, 1361-1366.

Beland, F., Lemay, A., Philibert, L., Maheux, B., & Gravel, G. (1991). Elderly patients - use of hospital-based emergency services. Medical Care, 29, 408-418.

Bigbee, J.L. (1993). The uniqueness of rural nursing. Nursing Clinics of North America, 28, 131-144.

Blazer, D., Landerman, L., Fillenbaum, G., & Horner, R. (1995). Healthcare services access and use among older adults in North Carolina: Urban vs. rural residents. American Journal of Public Health, 85, 1384-1390.

Bonneux, L., Barendregt, J., Meeter, K., Bonsel, G., & van der Maas, P. (1994). Estimating clinical morbidity due to ischemic heart disease and congestive heart failure: The future rise of heart failure. American Journal of Public Health, 84, 20-28.

Brass-Mynderse, N. (1996). Disease management for chronic congestive heart failure. Journal of Cardiovascular Nursing, 11(1), 54-62.

Brooten, D., Naylor, M., Brown, L., York, R., Hollingsworth, A., Roncoli, M., & Jacobsen, B. (1996). Profile of postdischarge rehospitalizations and acute care visits for seven patient groups. Public Health Nursing, 13, 128-134.

Campion, D.M., & Dickey, D.F. (1995). Lessons from the Essential Access Community Hospital program for rural health network development. Journal of Rural Health, 11, 32-39.

Cardiology Pre-eminence Roundtable (1994). Beyond four walls: Cost effective management of congestive heart failure. Washington, DC: The Advisory Board Co.

Casey, M., Wellever, A., & Moscovice, I. (1997). Rural health network development: Public policy issues and state initiatives. Journal of Health Politics, 22(1), 23-47.

Castaneda-Mendez, K., & Bernstein, L. (1997). Linking costs and quality improvement to clinical outcomes through added value. Journal of Healthcare Quality, 19(2), 11-16.

Center for Health & Environmental Statistics. (1996). Annual Summary of Vital Statistics, Kansas, 1995. Topeka, KS: Kansas Department of Health & Environment.

Charlson, M.E., Pompei, P., Ales, K.L., & MacKenzie, C.R. (1987). A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. Journal of Chronic Disease, 40, 373-383.

Charlson, M., Szatrowski, T.P., Peterson, J., & Gold, J. (1994). Validation of a combined comorbidity index. Journal of Clinical Epidemiology, 47, 1245-1251.

Chin, M., & Goldman, L. (1997). Correlates of early hospital readmission or death in patients with congestive heart failure. American Journal of Cardiology, 79, 1640-1644.

Cohen, J. (1992). A power primer. Psychological Bulletin, 112, 155-159.

Cohen, M., & MacWilliam, L. (1995). Measuring the health of the population. Medical Care, 33, DS21-DS42.

Comer, J., & Mueller, K. (1995). Access to health care: Urban-rural comparisons from a midwestern agricultural state. Journal of Rural Health, 11, 128-135, 138-140.

Concato, J., Feinstein, A.R., & Holford, T.R. (1993). The risk of determining risk with multivariable models. Annals of Internal Medicine, 118, 201-210.

CONSENSUS Trial Study Group. (1987). Effects of enalapril on mortality in severe congestive heart failure. New England Journal of Medicine, 316, 1429-1435.

Cordes, S., Doeksen, G.A., & Shaffer, R. (1994). Rural economic development and healthcare services. In J.E. Beaulieu & D.E. Berry (Eds.), Rural healthcare services: A management perspective (pp. 27-56). Ann Arbor, MI: APHA Press/Health Administration Press.

Covinsky, K.E., Justice, A.C., Rosenthal, G.E., Palmer, R.M., & Landefeld, C.S. (1997). Measuring prognosis and case mix in hospitalized elders. Journal of General Internal Medicine, 12, 203-208.

Davis, D.J., & Droes, N.S. (1993). Community health nursing in rural and frontier counties. Nursing Clinics of North America, 28(1), 159-169.

Deedwania, P.C. (1994). Prevalence and prognosis of heart failure. Cardiology Clinics, 12, 1-8.

Donabedian, A. (1980). Explorations in quality assessment and monitoring: The definition of quality and approaches to its assessment (Vol. 1). Ann Arbor, MI: Health Administration Press.

Doughty, R.N., & Sharpe, N. (1997). Beta-adrenergic blocking agents in the treatment of congestive heart failure. Annual Review of Medicine, 48, 103-114.

Dracup, K. (1996). Heart failure secondary to left ventricular systolic dysfunction. Therapeutic advances and treatment recommendations. Nurse Practitioner, 21(9), 56, 58, 61, 65-68.

Dracup, K., Baker, D., Dunbar, S., Dacey, R., Brooks, N., Johnson, J., Oken, C., & Massie, B. (1994). Management of heart failure: Counseling, education, and lifestyle modifications. Journal of American Medical Association, 272, 1442-1446.

Dracup, K., Moser, D.K., Marsden, C., Taylor, S.E., & Guzy, P.M. (1991). Effects of a multidimensional cardiopulmonary rehabilitation program on psychosocial function. Cardiac Rehabilitation and Psychosocial Status, 68, 31-34.

Dracup, K. Walden, J., Stevenson, L., & Brecht, M. (1992). Quality of life in patients with advanced heart failure. Journal of Heart Lung Transplant, 11, 273-279.

Edelman, M.A., & Menz, B.L. (1996). Selected comparisons and implications of a national rural and urban survey on health care access, demographics, and policy issues. Journal of Rural Health, 11, 197-205.

Eriksson, H. (1995). Heart failure: A growing public health problem. Journal of Internal Medicine, 237, 135-141.

Fonarow, G., Stevenson, L., Walden, J., Livingston, N., Steimle, A., Hamilton, M., Moriguchi, J., Tillisch, J., & Woo, M. (1997). Impact of a comprehensive heart failure management program on hospital readmission and functional status of patients with advanced heart failure. Journal of American College of Cardiology, 30, 725-732.

Franciosa, J.A. (1987). Why patients with heart failure die: Hemodynamic and functional determinants of survival. Circulation, 75(suppl. IV), 20-27.

Funk, M., & Krumholz, H. (1996). Epidemiologic and economic impact of advanced heart failure. Journal of Cardiovascular Nursing, 10(2), 1-10.

137

Gamm, L.D., Kassab, C.D., Brannon, S.D., & Fennell, M.L. (1996). Linkage strategies of rural hospitals - Independent hospital, local health system, and/or externally linked facility. Hospital & Healthcare services Administration, 41, 236-254.

Garnick, D., DeLong, E., & Luft, H. (1995). Measuring hospital mortality rates: Are 30-day data enough? Healthcare services Research, 29, 679-695.

Garnick, D.W., Hendricks, A.M., & Comstock, C.B. (1994). Measuring quality of care: Fundamental information from administrative data sets. International Journal of Quality in Health Care, 6, 163-177.

Ghali, J.K., Cooper, R., & Ford, E. (1990). Trends in hospitalization for heart failure in the United States, 1973-1986: Evidence for increasing population prevalence. Archives of Internal Medicine, 150, 769-773.

Gillum, R.F. (1993). Epidemiology of heart failure in the United States. American Heart Journal, 126, 1042-1047.

Gooding, J., & Jette, A. (1985). Hospital readmissions among the elderly. Journal of American Geriatrics Society, 33, 595-601.

Graves, E.J. (1992). Detailed diagnoses and procedures. National Hospital Discharge Survey. 1990. (Vital and Health Statistics; Series 13, No. 113 DHEW publ. no. 92-1774). Hyattsville, MD: National Center for Health Statistics.

Graves, E.J. (1995). 1993 Summary: National Hospital Discharge Survey. Advance data from vital and health statistics (publ. no. 264). Hyattsville, MD: National Center for Health Statistics.

Guyatt, G. (1987). Use of the six-minute walk test as an outcome measure in clinical trials in chronic heart failure. Heart Failure, 3, 211-217.

Guyatt, G., Nogradi, S., Halcrow, S., Singer, J., Sullivan, M., & Fallen, E. (1989). Development and testing of a new measure of health status for clinical trials in heart failure. Journal of General Internal Medicine, 4, 101-107.

Guyatt, G.H., Sullivan, M.J., Fallen, E.L., Pugsley, S.O., Taylor, D.W., & Berman, L.B. (1985). The six minute walk: A new measure of exercise capacity in patients with chronic heart failure. Canadian Medical Association Journal, 132, 919-923.

Hadorn, D., Baker, D., Dracup, K., & Pitt, B. (1994). Making judgments about treatment effectiveness based on health outcomes: Theoretical and practical issues. Journal on Quality Improvement, 20, 547-554.

Hamdy, R., Forrest, L., Moore, S., & Cancellaro, L. (1997). Use of emergency departments by the elderly in rural areas. Southern Medical Journal, 90, 616-620.

Happ, M., Naylor, M., & Roe-Prior, P. (1997). Factors contributing to rehospitalization of elderly patients with heart failure. Journal of Cardiovascular Nursing, 11(4), 75-84.

Herlitz, J., Albertsson, P., Brandrup-Wognsen, G., Emanuelsson, H., Haglid, M., Hartford, M., Hjalmarson, A., Karlson, B., Karlsson, T., & Sanden, W. (1997). Predictors of hospital readmission two years after coronary artery bypass grafting. Heart, 77, 437-442.

Hicks, L., & Bopp, K. (1996). Integrated pathways for managing rural healthcare services. Health Care Management Review, 21(1), 65-72.

Ho, K., Pinsky, J., Kannel, W.B., & Levy, D. (1993). The epidemiology of heart failure: The Framingham study. Journal of American College of Cardiology, 22(Suppl. A), 6-13A.

Hofer, T., & Hayward, R. (1995). Can early re-admission rates accurately detect poor-quality hospitals? Medical Care, 33, 234-245.

Holloway, J.J., Medendorp, S.V., & Bromberg, J. (1990). Risk factors for early readmission among veterans. Healthcare services Research, 25(1, Part 2), 213-217.

Hornberger, C.A. (1997). Understanding rural access and utilization issues for patients with cardiopulmonary disease in Kansas. Manuscript in preparation.

Hornberger, C.A., & Cobb, A.K. (1998). A rural vision of a healthy community. Public Health Nursing, 15, 363-369.

Horner, S., Ambrogne, J., Coleman, M., Hanson, C., Hodnicki, D., Lopez, S., & Talmadge, M.C. (1994). Traveling for care: Factors influencing health care access for rural dwellers. Public Health Nursing, 11, 145-149.

Hungerford, M., & Simpson, T.C. (1991). The EACH Project. Part I: The basics. <u>Kansas Medicine, 92</u>(10), 243-245.

Hunt, R.C., DeHart, K.L., Allison, E.F., & Whitley, T.W. (1996). Patient and physician perception of need for emergency medical care: A prospective and retrospective analysis. <u>American Journal of Emergency Medicine, 14,</u> 635-639.

Iezzoni, L., Ash, A., Shwartz, M., Daley, J., Hughes, J., & Mackiernan, Y. (1995). Predicting who dies depends on how severity is measured: Implications for evaluating patient outcomes. <u>Annals of Internal Medicine, 123,</u> 763-770.

Kassab, C., Luloff, A.E., Kelsey, T.W., & Smith, S.M. (1996). The influence of insurance status and income on health care use among the nonmetropolitan elderly. <u>Journal of Rural Health, 12,</u> 89-99.

Kannel, W.B. (1989). Epidemiological aspects of heart failure. <u>Cardiology Clinics, 7</u>(1), 1-9.

Kennedy, L., Neidlinger, S., & Scroggin, K. (1987). Effective comprehensive discharge planning for hospitalized elderly. <u>Gerontologist, 27,</u> 577-580.

Knaus, W.A., Wagner, D.P., Zimmerman, J.E., & Draper, E.A. (1993). Variations in mortality and length of stay in intensive care units. <u>Annals of Internal Medicine, 118,</u> 753-761.

Konstam, M.A., Dracup, K., Baker, D.W., Bottorff, M.B., Brooks, N.H., Dacey, R.A., Dunbar, S.B., Jackson, A.B., Jessup, M., Johnson, J.C., Jones, R.H., Luchi, R.J., Massie, B.M., Pitt, B., Rose, E.A., Rubin, L.J., Wright, R.F., & Hadorn, D.C. (1994). Heart failure: Evaluation and care of patients with left-ventricular systolic dysfunction. (AHCPR Publ. No. 94-0612). Rockville, MD: Public Health Service, U.S. Department of Health and Human Services, Agency for Health Care Policy and Research.

Krout, J. (1986). The age in rural America. New York: Greenwood.

Krout, J. (Ed.). (1994). Providing community based services in the elderly. Thousand Oaks, CA:Sage.

Krumholz, H.M., Wang, Y., Parent, E.M., Mockalis, J., Petrillo, M., & Radford, M.J. (1997). Quality of care for elderly patients hospitalized with heart failure. Archives of Internal Medicine, 157, 2242-2247.

Langner, B. (1998). The EACH-RPCH approach to protect access of rural Medicare beneficiaries to health care. Manuscript commissioned by the Robert Wood Johnson Foundation.

Lantz, P.M., House, J.S., Lepkowski, J.M., Williams, D.R., Mero, R.P., & Chen, J. (1998). Socioeconomic factors, health behaviors, and mortality. Journal of American Medical Association, 279, 1703-1708.

Lazarre, M., & Ax, S. (1997). Assessment - patients, chronic heart failure, and home care. Caring, 16(6), 20-22.

Lee, H.J. (1993). Rural elderly individuals. Strategies for delivery of nursing care. Nursing Clinics of North America, 28, 219-230.

Lindberg, C.C. (1997). Implementation of in-home telemedicine in rural Kansas: Answering an elderly patient's needs. Journal of the American Medicine Informatics Association, 4(1), 14-17.

Link, B.G., & Phelan, J.C. (1996). Understanding the sociodemographic differences in health: The role of fundamental social causes. American Journal of Public Health, 86, 471-473.

Lubitz, J., Gornick, M., Mentnech, R., & Loop, F. (1993). Rehospitalizations after coronary revascularization among Medicare beneficiaries. American Journal of Cardiology, 72, 26-30.

Luft, H.S.,, Garnick, D.W., Mark, D.H., Peltzman, D.J., Phibbs, C.S., Lichtenberg, E., & McPhee, S.J. (1990). Does quality influence choice of hospital? Journal of American Medical Association, 263, 2899-2906.

Marmot, M.G. (1996). Socio-economic factors in cardiovascular disease. Journal of Hypertension, 14(suppl 5), S201-205.

Marmot, M.G., Bosma, H., Hemingway, H., Brunner, E., & Stansfeld, S. (1997). Contribution of job control and other risk factors to social variations in coronary heart disease incidence. Lancet, 350, 235-239.

Marmot, M., Rose, G., Shipley, M., & Hamilton, P. (1978). Employment grade and coronary heart disease in British civil servants. Journal of Epidemiology and Community Health, 32, 244-249.

Marmot, M., Ryff, C.D., Bumpass, L.L., Shipley, M., & Marks, N.F. (1997). Social inequalities in health: Next questions and converging evidence. Social Science & Medicine, 44(6), 901-910.

Marmot, M.G., Smith, G.D., Stansfeld, S., Patel, C., North, F., Head, J., White, I., Brunner, E., & Feeney, A. (1991). Health inequalities among British civil servants: The Whitehall study. Lancet, 337, 1387-1393.

McConnell, C.E., & Zetzman, M.R. (1993). Urban/rural differences in health service utilization by elderly patients in the United States. Journal of Rural Health, 9, 270-280.

Miller, M.G., Miller, L.S., Fireman, B., & Black, S.B. (1994). Variation in practice for discretionary admissions. Journal of the American Medical Association, 271, 1493-1498.

Mittelmark, M., Psaty, B., Rautaharju, P., Fried, L., Borhani, M., Tracy, R., Gardin, J., & O'Leary, D. (1993). Prevalence of cardiovascular diseases among older adults: The Cardiovascular Health Study. American Journal of Epidemiology, 137, 311-317.

Morrisey, M.A., Ohsfeldt, R.L., Johnson, V., & Treat, R. (1995). Rural emergency medical services: Patients, destinations, times, and services. Journal of Rural Health, 11, 286-294.

Moser, D., & Dracup, K. (1995). Psychosical recovery from a cardiac event: The influence of perceived control. Heart & Lung, 24, 273-280.

Murphy, J.F., & Hepworth, J.T. (1996). Age and gender differences in healthcare services utilization. Research in Nursing and Healthcare, 19, 323-329.

National Center for Health Statistics (1991). Vital and health statistics: Current estimates from the National Health Interview Survey, 1990 (Series 10, No. 181). Hyattsville, MD: Health & Human Services.

National Rural Health Association. (1992a). National health policy reform: The rural perspective. Kansas City, MO: Author.

National Rural Health Association. (1992b). Study of models to meet rural health care needs through mobilization of health professions education and services resources. Kansas City, MO: Author.

Naylor, M., Brooten, D. Jones, R., Lavizzo-Mourey, R., Mezey, M., & Pauly, M. (1994). Comprehensive discharge planning for the hospitalized elderly. Annals of Internal Medicine, 120, 999-1006.

Office of Local & Rural Health. (1997). Defining Rural Kansas. Topeka, KS: Kansas Department of Health and Environment.

Omnibus Budget Reconciliation Act of 1989 Conference Report, H.R. 3299, 101st Cong., 1st Sess. (1989).

Optenberg, S.A., Jacobs, P., Bay, K., Barer, D.J., & Hall, E.M. (1995). Emergency care episodes: An economic profile. Journal of Ambulatory Care Management, 18(1), 1-12.

Office of Rural Health Policy. (1990, May). Success and failure: A study of rural emergency medical services. Washington, DC: National Rural Health Association.

Packer, M. (1996). Do angiotensin-converting enzyme inhibitors prolong life in patients with heart failure treated in clinical practice? Journal of American College of Cardiology, 28, 1323-1327.

Penchansky, R., & Thomas, J.W. (1981, February). The concept of access: Definition and relationship to consumer satisfaction. Medical Care, 19, 127-140.

Pernenkil, R., Vinson, J., Shah, A., Backham, V., Wittenberg, C., & Rich, M. (1997). Course and prognosis in patients ≥ 70 years of age with congestive heart failure and normal versus abnormal left ventricular ejection fraction. American Journal of Cardiology, 79, 216-219.

Philbin, E., Lynch, L., Rocco, T., Lindenmuth, N., Ulrich, K., McCall, M., Jenkins, P., & Roerden, J. (1996). Does QI work? The Management to Improve Survival in Congestive Heart Failure (MISCHF) study. Journal on Quality Improvement, 22, 721-733.

Piette, J., & Moos, R. (1996). Influence of distance following myocardial infarction. Healthcare services Research, 31, 573-591.

Pompei, P., Charlson, M.E., Ales, K., MacKenzie, C.R., & Norton, M. (1991). Relating patient characteristics at the time of admission to outcomes of hospitalization. Journal of Clinical Epidemiology, 44, 1063-1069.

Redeker, N., & Brassard, A.B. (1996). Health patterns of cardiac surgery clients using home health care nursing services. <u>Public Health Nursing, 13,</u> 394-403.

Reis, S., Holubkov, R., Edmundowicz, D., McNamara, D., Zell, K., Detre, K., & Feldman, A. (1997). Treatment of patients admitted to the hospital with congestive heart failure: Specialty-related disparities in practice patterns and outcomes. <u>Journal of American College of Cardiology, 30,</u> 733-738.

Reitsma, J.B., Mosterd, A., de Craen, A., Koster, R., van Capelle, F., Grobbee, D., Tijssen, J. (1996). Increase in hospital admission rates for heart failure in the Netherlands, 1980-1993. <u>Heart, 76,</u> 388-392.

Rich, M. (1997). Epidemiology, pathophysiology, and etiology of congestive heart failure in older adults. <u>Journal of American Geriatrics Society, 45,</u> 968-974.

Rich, M.W., & Freedland, K.E. (1988). Effect of DRGs on three-month readmission rate of geriatric patients with congestive heart failure. <u>American Journal of Public Health, 78,</u> 680-682.

Rich, M.W., Beckham, V., Wittenberg, C., Leven, C.L., Freedland, K.E., & Caney, M. (1995). A multidisciplinary intervention to prevent the readmission of elderly patients with congestive heart failure. <u>New England Journal of Medicine, 333,</u> 1190-1195.

Rich, M., Vinson, J., Sperry, J., Shah, A., Spinner, L., Chung, M., & Davila-Roman, V. (1993). Prevention of readmission in elderly patients with congestive heart failure: Results of a prospective, randomized pilot study. Journal of General Internal Medicine, 8, 585-590.

Rideout, E., & Montemuro, M. (1986). Hope, morale, and adaptation in patients with chronic heart failure. Journal of Advanced Nursing, 11, 429-438.

Riley, G., Lubitz, J., Gornick, M., Mentnech, R., Eggers, P., & McBean, M. (1993). Medicare beneficiaries: Adverse outcomes after hospitalization for eight procedures. Medical Care, 31, 921-949.

Schocken, D.D., Arrieta, M.I., Leaverton, P.E., & Ross, E.A. (1992). Prevalence and mortality rate of congestive heart failure in the United States. Journal of American College of Cardiology, 20, 301-306.

Schultz, A. (1997). Identification of needs of and utilization of resources by rural and urban elders after hospital discharge to the home. Public Health Nursing, 14, 28-36.

Shreffler, M.J. (1996). An ecological view of the rural environment: Levels of influence on access to health care. Advances in Nursing Science, 18(4), 48-59.

Singh, G.K., Wilkinson, A.V., Song, F.F., Rose, T.P., Adrian, M., Fonner, E., & Tarlov, A. (1998). Health and Social Factors in Kansas: A Data and Chartbook, 1997-1998. Topeka, KS: Kansas Health Institute.

Smith, M.G., Andersen, R.T., Bradham, D.D., & Longino, C.F. (1995). Rural and urban differences in mortality among Americans 55 years and older: Analysis of the national longitudinal mortality study. Journal of Rural Health, 11, 274-283.

Stewart, M., Hirth, A., Klassen, G., Makrides, L., & Wolf, H. (1997). Stress, coping, and social support as psychosocial factors in readmissions for ischaemic heart disease. International Journal of Nursing Studies, 34, 151-163.

Strange, G., Chen, E., & Sanders, A. (1992). Use of emergency departments by elderly patients: Projections from a multicenter data base. Annals of Emergency Medicine, 21, 819-824.

Tandon, P.K. , Stander, H., & Schwarz, R.P. (1989). Analysis of quality of life data from a randomized, placebo-controlled heart-failure trial. Journal of Clinical Epidemiology, 42, 955-962.

Taunton, R.L., Redford, L., Cobb, A.K., Wright, L., & Forbes, S. (1995). Horton, Kansas: Community perceptions of health care. Unpublished manuscript. University of Kansas School of Nursing, Kansas City, KS.

The SOLVD Investigators. (1991). Effect of enalapril on survival in patients with reduced left ventricular ejection fractions and congestive heart failure. New England Journal of Medicine, 325, 293-302.

United States Bureau of the Census. (1990). <u>General population characteristics of the United States</u> (Series CP-1-1). Washington, DC: US Government Printing Office.

United States Department of Health & Human Services. (1994). <u>Heart failure: Management of patients with left-ventricular systolic dysfunction</u> (AHCPR Publ. No. 94-0613). Washington, DC: Author.

United States General Accounting Office. (1998, February). <u>Rural primary care hospitals: Experience offers suggestions for Medicare's expanded program</u> (GAO Publication No. HEHS-98-60). Washington, DC: Author.

United States General Accounting Office. (1993, January). <u>Emergency departments, unevenly affected by growth and change in patient use</u> (GAO Publication No. B-2513129). Washington, DC: Author.

Venner, G., & Seelbinder, J. (1996). Team management of congestive heart failure across the continuum. <u>Journal of Cardiovascular Nursing, 10</u>(2), 71-84.

Vinson, J., Rich, M., Sperry, J., Shah, A., & McNamara, T. (1990). Early readmission of elderly patients with congestive heart failure. <u>Journal of American Geriatrics Society, 38,</u> 1290-1295.

Walden, J., Stevenson, L., Dracup, K., Hook, J., Moser, D., Hamilton, M., & Fonarow, G. (1994). Extended comparison of quality of life between stable heart failure patients and heart transplant recipients. Journal of Heart Lung Transplant, 13, 1109-1118.

Washington State Department of Health. (1996). Definition of Rural County Types. Olympia, WA: Author.

Weingarten, S., Riedinger, M., Conner, L., Johnson, B., & Ellrodt, A.G. (1994). Reducing lengths of stay in the coronary care unit with a practice guideline for patients with congestive heart failure: Insights from a controlled clinical trial. Medical Care, 32, 1232-1243.

Wennberg, J., & Gittelsohn, A. (1982). Variations in medical care among small areas. Scientific American, 246(4), 120.

Williams, D.R., & Collins, C. (1995). US socioeconomic and racial differences in health: Patterns and explanations. Annual Review of Sociology, 21, 349-386.

Wolinsky, F.D., Overhage, J.M., Stump, T.E., Lubitz, R.M., & Smith, D.M. (1997). The risk of hospitalization for congestive heart failure among older adults. Medical Care, 35, 1031-1043.

Wolinsky, F., Smith, D. , Stump, T., Overhage, J.M., & Lubitz, R. (1997). The sequelae of hospitalization for congestive heart failure among older adults. Journal of American Geriatrics Society, 45, 558-563.

Zuvekas, A., Leifer, J.C., Rosenbaum, E., & Hughes, R. (1997). Linking primary care centers and hospitals. Journal of Ambulatory Care Management, 20(1), 65-76.

Appendix A

DEFINITION OF KANSAS COUNTIES

Using Metropolitan Statistical Areas and Population Density

Frontier (30)	Rural (45)	Densely-settled Rural (21)	MSA (9)
Barber	Andersen	Allen	Butler
Chase	Bourbon	Atchison	Douglas
Cheyenne	Brown	Barton	Harvey
Clark	Chautauqua	Cherokee	Johnson
Comanche	Clay	Cowley	Leavenworth
Decatur	Cloud	Crawford	Miami
Edwards	Coffey	Ellis	Sedgwick
Elk	Dickinson	Finney	Shawnee
Gove	Doniphan	Ford	Wyandotte
Graham	Ellsworth	Franklin	
Greeley	Grant	Geary	
Hodgeman	Gray	Jefferson	
Jewell	Greenwood	Labette	
Kearney	Hamilton	Lyon	
Kiowa	Harper	McPherson	
Lane	Haskell	Montgomery	
Lincoln	Jackson	Neosho	
Logan	Kingman	Reno	
Meade	Linn	Riley	
Morton	Marion	Saline	
Ness	Marshall	Seward	
Osborne	Mitchell		
Rawlins	Morris		
Rush	Nemaha		
Sheridan	Norton		
Smith	Osage		
Stanton	Ottawa		
Trego	Pawnee		
Wallace	Phillips		
Wichita	Pottawatomie		
	Pratt		
	Republic		
	Rice		
	Rooks		
	Russell		
	Scott		
	Sherman		
	Stafford		
	Stevens		
	Sumner		
	Thomas		
	Wabaunsee		
	Washington		
	Wilson		
	Woodson		

Definitions

Frontier: Counties that have a population density of six persons per square mile or less.

Rural: Counties with 6 to 25 persons per square mile.

Densely-settled Rural: Counties with more than 25 persons but less than a MSA.

Metropolitan Statistical Area (MSA): Counties that meet the definition, a large population nucleus, together with adjacent communities that have a high degree of economic and social integration with that nucleus. An MSA must have a city of 50,000 or more and a total MSA population of at least 100,000.

Note. Population density designation is defined by the Office of Management and Budget, and the Department of Agriculture's Rural-Urban Continuum Codes. Cite: Office of Technology Assessment (1990). Health care in rural America (OTA Publication No. OTA-H-434). Washington, DC: U.S. Government Printing Office.

Appendix B

County Groupings

County Cluster	Counties	Population ≥ 65 years	Number of index events
Frontier			
1	Barber, Comanche	1,730	20
2	Cheyenne, Decatur, Rawlins	2,340	31
3	Clark, Edwards, Kiowa, Meade	2,970	35
4	Graham, Rush, Trego	2,900	49
5	Gove, Logan, Sheridan, Wallace	2,110	23
6	Hodgeman, Lane, Ness	1,740	28
7	Jewell, Smith	2,320	22
8	Lincoln, Osborne	2,170	42
9	Greeley, Kearney, Morton, Stanton, Kearney, Wichita	1,930	26
10	Chase, Elk	1,640	19
Rural			
11	Andersen, Coffey	3,530	42
12	Bourbon, Linn	5,070	67
13	Brown	2,430	30
14	Clay, Ottawa	3,350	35
15	Cloud	2,610	39
16	Dickinson	4,050	42
17	Ellsworth, Rice	3,510	37

County Cluster	Counties	Population ≥ 65 years	Number of index events
Rural			
18	Grant, Hamilton, Stevens	1,970	27
19	Chautauqua, Greenwood	3,210	36
20	Harper, Sumner	6,070	58
21	Doniphan, Jackson	3,370	22
22	Marion, Morris	4,470	39
23	Pottawatomie, Waubaunsee	3,860	27
24	Gray, Haskell, Scott	1,980	25
25	Kingman, Pawnee, Stafford	2,860	41
26	Marshall	2,600	29
27	Nemaha	2,190	36
28	Norton, Phillips, Rooks	5,260	49
29	Osage	3,000	28
30	Pratt	1,875	32
31	Mitchell, Republic, Washington	5,050	57
32	Russell	1,850	28
33	Sherman, Thomas	2,370	27
34	Wilson, Woodson	3,350	36
Dense Rural			
35	Allen	2,850	28
36	Barton	4,950	52
37	Cherokee, Labette	8,390	48
38	Cowley	6,200	53

County Cluster	Counties	Population ≥ 65 years	Number of index events
Dense Rural			
39	Crawford	7,310	97
40	Ellis	3,660	45
41	Finney	2,850	32
42	Ford, Seward	5,720	52
43	Franklin, Jefferson	6,290	67
44	Geary	2,410	23
45	Riley	4,800	32
46	Atchison	2,800	44
47	Lyon	4,460	57
48	McPherson	4,880	76
49	Montgomery	7,410	101
50	Neosho	3,330	38
51	Reno	10,630	110
52	Saline	7,650	61
Metropolitan statistical area			
53	Butler	7,990	67
54	Douglas	7,670	60
55	Harvey	5,310	65
56	Johnson	39,780	211
57	Leavenworth	6,820	54
58	Miami	3,560	33

County Cluster	Counties	Population $\geq$ 65 years	Number of index events
Metropolitan statistical area			
59	Sedgwick	49,810	481
60	Shawnee	22,350	162
61	Wyandotte	20,170	210